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Introduction

WHAT *STAR* IS

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INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1622**

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **1626**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **1658**

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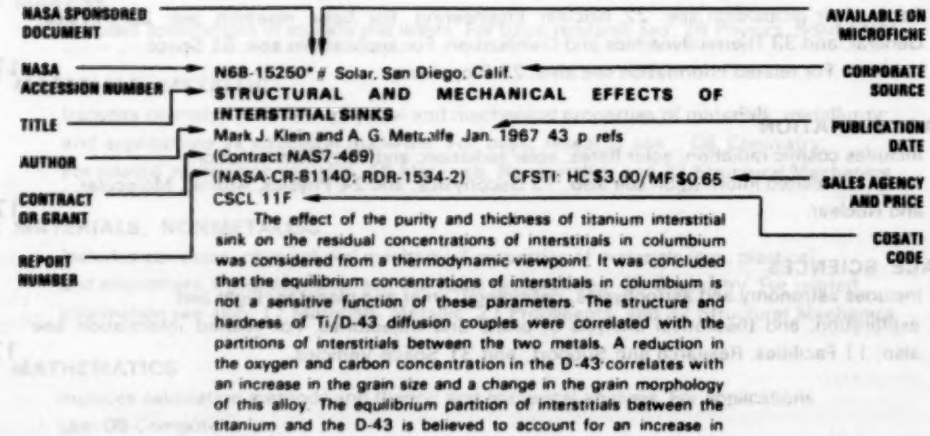
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140, RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N68-20593# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

NEAR WAKE MEASUREMENTS IN THE PRESENCE OF AN INSTRUMENTATION BOOM

Robert J. Cresci and Edward M. Schmidt Nov. 1967 32 p refs (Contract Nonr-839(38); ARPA Order 529; Proj. Defender) (PIBAL-1034; AD-665297)

A series of experimental tests were run to determine the effect on the near wake flow field of inserting an instrumentation boom in the base region of a sharp cone. Test data were obtained for a free stream Mach number of 7.7, Reynolds numbers corresponding to either completely laminar or fully turbulent flow on the cone surface, and for a 10 degree half angle cone with a boom length of one and a half base diameters. The data were compared to the clean base configuration and it was found that the adjacent flow field was disturbed considerably by the presence of the boom. Author (TAB)

N68-21046 California Univ., Berkeley.

BIVARIATE FREQUENCY DISTRIBUTIONS OF PRESSURE ALTITUDE AND TEMPERATURE AND THEIR EFFECT ON RUNWAY LENGTHS

Thomas Bernard Davinroy (Ph.D. Thesis) 1966 109 p Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4982

Variations in pressure altitude have an effect on the length of runway required for take-off of an aircraft from an airport. The present methods for computing runway lengths consider variations in temperture but not variations in pressure altitude. The purpose of this study was to determine the effect of pressure altitude variations on required runway lengths and allowable take-off weights. Values of pressure altitude and temperature for ten airports were combined with take-off weights for each of four turbo-jet, transport-category aircraft producing required runway lengths. Since the values of pressure altitude and temperature had frequency distributions, the runway lengths also had frequency distributions. It was found that net decrease in required runway length would result over an extended period of time for any specific take-off weight if values of pressure altitude were used instead of airport elevation. It was also found that a net increase in allowable take-off weight for a specific runway length could be realized if values of pressure altitude were used instead of airport elevation. Dissert. Abstr.

N68-21178# Royal Aircraft Establishment, Farnborough (England).

THE PRESSURE, LIFT AND MOMENT DISTRIBUTIONS ON A HARMONICALLY OSCILLATING SWEPTBACK WING OF LOW ASPECT RATIO AT LOW SUBSONIC SPEEDS. COMPARISON BETWEEN THEORY AND MEASUREMENTS

B. Laschka Apr. 1967 16 p refs Presented at the Proc. of the Intern. Council of the Aeron. Sci., 4th Congr., Paris, 1964 (RAE-LIB-TRANS-1223) CFSTI: $3.00

The computational procedures for determining the non-stationary aerodynamic coefficients of importance in stability and flutter studies have recently reached a satisfactory state as regards calculations based on linear theory however, we still lack an overall check on the agreement of measured with calculated non-stationary aerodynamic forces. Therefore there has been carried out extensive pressure distribution measurements on a harmonically excited sweptback wing with and without outboard nacelles at low subsonic speeds. Measurements were also made for rigid body modes (heaving, rolling, pitching, flap and rudder rotation) at relatively high reduced frequencies. Some of these experimental results have been compared with theoretical values obtained by means of a kernel function method. Author

N68-21300# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

EXPERIMENTAL INVESTIGATION OF WING-BODY INTERFERENCES IN THE MACH NUMBER RANGE MA = 0.5 TO MA = 2.0 [EXPERIMENTELLE BESTIMMUNG VON FLUEGEL-RUMPF-INTERFERENZEN IM MACHZAHLBEREICH MA = 0,5 BIS MA = 2,0]

W. Schneider Dec. 1967 43 p refs In GERMAN; ENGLISH summary (DLR-FB-67-93; AVA-FB-6709; DK-553, 695.6) CFSTI: HC $3.00/MF $0.65

In order to investigate the effects of interference on wing-body combinations tests were conducted in the transonic wind tunnel in a Mach number range from Ma = 0.5 to Ma = 2.0. Three basic wings, a rectangular wing, a sweptback wing, and a delta wing were tested alone and in combination with two pointed, cylindrical bodies of different length and diameter. For these wing-body combinations the interference effects in the lift, in the pitching moment, in the wave resistance and the shift of the aerodynamic center due to interferences were determined. Author

N68-21374*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAM FOR CALCULATING VELOCITIES AND STREAMLINES ON A BLADE-TO-BLADE STREAM SURFACE OF A TURBOMACHINE

Theodore Katsanis Washington Apr. 1968 100 p refs (NASA-TN-D-4525) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A FORTRAN IV computer program was written that gives the solution of the two-dimensional, subsonic, compressible (or incompressible), nonviscous flow problem for a rotating or stationary circular cascade of blades on a blade-to-blade surface of revolution.

The flow may be axial, radial, or mixed. There may be a change in stream channel thickness in the through-flow direction. The computer program requires the basic cascade geometry, the meridional stream channel coordinates, fluid total conditions, weight flow, and inlet and outlet flow angles. The output includes streamline coordinates, velocity magnitude and direction throughout the passage, and the blade surface velocities. The method is based on the stream function with the solution of the simultaneous, nonlinear, finite-difference equations being obtained by two major levels of iteration. The inner iteration consists of the solution of simultaneous linear equations by successive overrelaxation, using an estimated optimum overrelaxation factor. The outer iteration then changes the coefficients of the simultaneous equations to compensate for compressibility. Author

N68-21487# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
ROTOR PERFORMANCE OF THE R32-2 BLUNT TRAILING EDGE BLADE SUPERSONIC COMPRESSOR
F. A. E. Breugelmans Apr. 1967 52 p refs
(Grant AF-EOAR-65-65)
(IN-20; ARL-68-0020; SR-3; AD-666047)

A second supersonic compressor R32-II is designed and tested. The basic design ideas, in view of the experience gained with the R32-I wheel, and the overall and detail performance are given. A study is made of the downstream mixing with its influence on outlet flow angle, axial Mach number and total pressure distribution. A comparative study is made between the two wheels. Author (TAB)

N68-21564 Dynasciences Corp., Blue Bell, Pa.
INVESTIGATION OF PROPELLER SLIPSTREAM EFFECTS ON WING PERFORMANCE Final Report, Mar. 1966–May 1967
M. George and E. Kisielowski Nov. 1967 213 p refs
(Contract DA-44-177-AMC-394(T))
(DCR-234; USAAVLABS-TR-67-67; AD-666247)

A theoretical and experimental study was conducted to determine the effects of propeller slipstream on wing performance. Previously developed theoretical analyses were expanded and modified to account for radial variation of the propeller slipstream velocity. The experimental program consisted of wind tunnel tests conducted with a motor-propeller system mounted on a semispan wing model. The wing model utilized has a chord to propeller diameter of 0.46, an aspect ratio of 6.37 (3.18 for semispan), a taper ratio of 1.0, and a NACA 0015 airfoil section. The wing model has eight floating wing segments with and without a 45-degree simulated split flap. Located within each floating wing segment is a three-component strain gage balance to provide measurements of lift, drag, and pitching moment. The measurements of total wing lift, drag, and pitching moment were obtained with the six-component main wind tunnel balance. The test data obtained included the effects of the variation of propeller slipstream velocity by utilizing two propellers of different geometries. Propeller rotation for all tests was down at the wing tip. The experimental and theoretical results are compared; in general, good correlation is observed. Author (TAB)

N68-21579*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTERFERENCE EFFECTS OF CANARD CONTROLS ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A WINGED BODY AT MACH 10
Cuyler W. Brooks, Jr. (M.S. Thesis—Virginia Univ.) Washington Apr. 1968 73 p refs
(NASA-TN-D-4436) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An experimental investigation of the interference effects of canard controls on two hypersonic winged configurations was made at a Mach number of 10 in the Langley 15-inch hypersonic flow apparatus. The effect of variations in canard size and shape, body length, wing planform, and wing vertical position was determined. The results indicate that the canard control induces a broad pattern of interference in which the average flow angle over the wing and body surfaces downstream of the canard varies significantly from the free-stream value. The magnitude of the interference increases with increasing canard deflection and, in general, with increasing angle of attack. The most significant configuration parameters (aside from canard deflection) are wing position and canard size. The low-wing configurations are affected considerably less by interference than the high-wing configurations, especially at higher angles of attack. As would be expected, the larger canard causes larger disturbances in the flow than does the smaller canard. Author

N68-21633# Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).
REPORT ON PROCEEDINGS HELD BY THE WGLR COMMITTEE ON AERODYNAMICS, ON JULY 10, 1967 IN DARMSTADT [BERICHT UEBER DIE SITZUNG DES WGLR-FACHAUSSCHUSSES FUER AERODYNAMIK AM 10 JULI 1967 IN DARMSTADT]
Nov. 1967 233 p refs In GERMAN; ENGLISH summary Conf. held in Darmstadt (West Germany), 10 Jul. 1967
(DLR-Mitt.-67-24) CFSTI: HC$3.00/MF$0.65

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N68-21634# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
DESIGN CONSIDERATIONS IN AIRPLANE WING AERODYNAMICS [ENTWURFSGERECHTE TRAGFLUEGE-LAERODYNAMIK]
F. Thomas *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 7–26 (See N68-21633 11-01)

Aerodynamic design considerations are reviewed for subsonic, transonic, and supersonic aircraft wings; accordingly, the review covers rectangular planforms, arrow wings, and slender delta wings. The overriding considerations in this brief study are optimization of the lift–drag ratio and the economy of the design with any given weight and thrust. Future trends in wing aerodynamics are also briefly discussed. Transl. by K.W.

N68-21635# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
AERODYNAMIC CONSTRUCTION OF TRANSPORT AIRPLANE WINGS FOR CRUISING FLIGHT AT HIGH SUBSONIC SPEEDS [AERODYNAMISCHE AUSLEGUNG DER TRAGFLUEGEL VON TRANSPORTFLUGZEUGEN FUER DEN REISEFLUG BEI HOHEN UNTERSCHALLGESCHWINDIGKEITEN]
H. Friedel and M. Lotz *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 27–99 refs (See N68-21633 11-01)

In addition to the principles of lifting-wing optimization, this paper treats problems connected with the compressible resistance increase occurring on wings. The two dimensional case of profile aerodynamics and the three dimensional case of conditions on the wing, particularly the arrow wing, are discussed. The mathematical requirements for wing design and for calculating profile and wing geometries are given, followed by a procedural outline of lifting-wing design for subsonic aircraft. Transl. by K.W.

N68-21636# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
A CONTRIBUTION TO THE DESIGN OF HORIZONTAL STABILIZERS AND ELEVATORS [EIN BEITRAG ZUR AUSLEGUNG VON HOEHENLEITWERKEN]
J. Barche and G. Krenz *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 100–120 (See N68-21633 11-01)

Problems arising from the often contradictory requirements in the design of tail assemblies for fast fighter aircraft are examined. These problems are mainly caused by the necessity for such aircraft to fly at varying speeds during transonic cruising, landing, and maneuvering. The effects of the body–wing configuration on the tail assembly design are analyzed. Aerodynamic characteristics, stabilizing effects, and control functions of several tail assembly configurations are discussed. Transl. by K.W.

N68-21637# Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
CALCULATIONS OF PRESSURE DISTRIBUTION ON INTERACTING WINGS IN SUBSONIC FLOW UNDER PARTIAL CONSIDERATION OF THE DEFORMATION OF VORTEX LAYERS [BERECHNUNG DER DRUCKVERTEILUNG GEGENSEITIG SICH BEEINFLUSSENDER TRAGFLAECHEN IN UNTERSCHALLSTROEMUNG UNTER TEILWEISER BERUECKSICHTIGUNG DER DEFORMATION DER WIRBELSCHICHT]
A. Laschka, A. Mueller, and G. Boehm *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 121–183 refs (See N68-21633 11-01)

A method is described for calculating the aerodynamic forces on interacting wing–tail assembly configurations in subsonic flow. The method makes allowance for angle of attack, downwash, camber, and variations in the wing–fuselage configuration. Based on the linear lifting-wing theory, the method also takes into account the nonlinear dependences on the angle of attack resulting from the vorticity layer and such special cases as ground effect, biplane construction, and the tandem concept. Transl. by K.W.

N68-21638# Hamburger Flugzeugbau G.m.b.H. (West Germany).
CRITERIA FOR THE AERODYNAMICAL EVALUATION OF A MODEL IN ITS EARLY STAGE OF DEVELOPMENT [ZUSAMMENSTELLUNG VON ARBEITSUNTERLAGEN FUER DIE AERODYNAMISCHE BEURTEILUNG EINES ENTWURFES IM FRUEHEN PROJEKTSTADIUM]
M. Molzow *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 184–222 refs (See N68-21633 11-01)

A procedure for compiling aerodynamic load and strength data for evaluating an aircraft in the initial design stages is outlined. Application of the procedure is demonstrated on three problems: (1) derivation of data to determine lift distribution, lift increase, and roll moment increase of various wing configurations; (2) interference and effects of engine pods mounted on the fuselage-aft on the lift distribution of a wing; and (3) a simplified method for calculating the lift increase of a wing–body configuration. Transl. by K.W.

N68-21672# Naval Ordnance Lab., White Oak, Md.
THE DRAG OF SLIGHTLY BLUNTED SLENDER CONES
W. Carson Lyons, Jr. and H. S. Brown 4 Jan. 1968 44 p refs
(NOLTR-68-3; AD-666553)

A computer program is presented for calculating the various components comprising the total drag coefficient for slightly blunted slender cones. The program is applicable for either the case of a completely laminar boundary layer or where transition occurs on the cone. Weak viscous interaction effects are taken into account. Local flow properties which exist at the outer edge of the boundary layer along the cone are also computed. Author (TAB)

N68-21681*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL PRESSURE DISTRIBUTIONS ON A BLUNT LIFTING-ENTRY BODY AT MACH 3.71
W. Douglas Morris and Lana M. Couch Washington Apr. 1968 53 p refs
(NASA-TN-D-4494) CFSTI: $3.00 CSCL 01A

An experimental investigation was conducted to determine the pressure distribution on a blunted 15° half-cone–wedge lifting-entry body. The tests were conducted at a Mach number of 3.71 and Reynolds numbers per foot of 2.81×10^6 and 4.68×10^6 (Reynolds numbers per meter of 9.22×10^6 and 15.35×10^6). The angle-of-attack range was from −40° to 40°, and the angle-of-sideslip range was from −10° to 10°. A modified Newtonian method was compared with the data and, in general, found to predict the trends as well as the magnitude over the angle-of-attack and angle-of-sideslip ranges. Author

N68-21692*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARATIVE STUDY OF MIXED- AND ISOLATED-FLOW METHODS FOR COOLED-TURBINE PERFORMANCE ANALYSES
Warren J. Whitney Washington Apr. 1968 39 p refs
(NASA-TM-X-1572) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The two methods are described and then compared by using two simplified example turbines, one being a two-stage impulse type and the other a two-stage reaction turbine. The agreement in efficiency predicted by the two methods is within ±0.01 for total coolant fractions up to 0.156 and within ±0.013 at the highest total coolant fraction considered, which was 0.22. Author

N68-21703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EXPERIMENTAL INVESTIGATION OF THE RESTART AREA RATIO OF A MACH 3.0 AXISYMMETRIC MIXED COMPRESSION INLET
Glenn A. Mitchell and Robert W. Cubbison Washington Apr. 1968 25 p refs
(NASA-TM-X-1547) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Restart area ratios were obtained for the test inlet from Mach number 2.5 to 3.0 and compared to ratios from other inlets. All inlets restarted with throat areas smaller than required by

theory to pass the flow through a simple normal shock at the cowl lip. Details of the unstarted inlet flow field were obtained at Mach 3. The unstarted inlet flow field was characterized by a separated region on the centerbody causing an oblique shock ahead of the throat. The size of the separated region was controlled by the inlet throat area, and the separation terminated at the throat station. The restart throat area was smaller than predicted because of the higher pressure recovery produced by the multiple shock structure. Author

N68-21783# Royal Aircraft Establishment, Farnborough (England).
DRAG MEASUREMENTS ON A SERIES OF AFTERBODIES AT TRANSONIC SPEEDS SHOWING THE EFFECT OF STING INTERFERENCE
A. G. Kurn Sep. 1966 44 p refs
(RAE-TR-66298) CFSTI: HC $3.00/MF $0.65

A number of axisymmetric afterbodies consisting of the basic profile, a tangent ogive with a fineness ratio of 3.33, and progressively truncated versions of this shape were tested at zero incidence over a Mach range from 0.8 to 1.3. Measurements were made of the afterbody pressure distribution, the base pressure, and the total drag with and without the presence of various rear stings. In general the drag, in the absence of a sting, was increased by truncating the ogive, but at supersonic speeds small truncations had little effect. The results at a given free stream Mach number show that, for the different stings fitted to each afterbody, there is an approximately linear relationship between afterbody drag and base pressure. Curves are presented whereby the measured total drag of the sting-mounted afterbody model may be corrected to obtain the true total drag in the absence of the sting. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-20599# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
THE "C"-LAUNCH TECHNIQUE FOR HIGH-ALTITUDE BALLOONS
Francis X. Doherty, Chester G. R. Czepyha, and Robert J. Reddy Dec. 1967 16 p Sponsored by DASA *Its* Instrumentation Papers No. 136
(AFCRL-67-0672; AD-665850)

During the period from 1961 through 1965, the Air Force Cambridge Research Laboratories developed the technique for launching high altitude plastic balloons directly from the manufacturers shipping crate. This technique was primarily designed to facilitate the handling, inflation, and launch of large balloons from small ships at sea. The paper describes the new launch procedure and the specialized equipment designed to support it. Author (TAB)

N68-20658# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
INVESTIGATION OF COMPOUND HELICOPTER AERODYNAMIC INTERFERENCE EFFECTS Final Report
Lawrence J. Bain and Anton J. Landgrebe Nov. 1967 388 p refs
(Contract DA-44-177-AMC-203(T))
(SER-50474; USAAVLABS-TR-67-44; AD-665427)

A generalized model of a compound helicopter was tested in a 18-foot wind tunnel to determine the nature of aerodynamic interferences between the rotor, the fuselage, and various wings, as well as the effects of these components on the downwash at the tail. In addition, a theoretical method for calculating the wing induced flow through the rotor is presented, and the theoretical results are correlated with the experimental results. In a second test the mutual interferences between a rotor and various propeller configurations were investigated. It was concluded from this work that the vibratory bending moments on wing-mounted tractor propellers are a direct function of the sum of the rotor momentum downwash angle and the geometric angle of attack while the vibratory bending moments on a tail-mounted pushed propeller have a relationship to the rotor lift which depends on the presence or absence of empennage forward of the propeller. It was also found that increasing thrust on wing-mounted tractor propellers generally causes increased rotor blade vibratory bending moments. TAB

N68-20712# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SUPPRESSION OF TRANSMITTED HARMONIC ROTOR LOADS BY BLADE Final Technical Report, Jun. 1965–Jul. 1966
Hamilton Daughaday Nov. 1967 94 p refs
(Contract DA-44-177-AMC-299(T))
(CAL-BB-2117-S-1; USAAVLABS-TR-67-14; AD-665430)

A method is developed for computing the pitch angle inputs required to eliminate the transmission of harmonic vertical forces from a helicopter rotor to its driving shaft. The inertia and aerodynamic forces due to dynamic blade motions are taken into account in the computations. In finding the aerodynamic loads, a realistic model is used which represents the wake vorticity by a mesh of segmented vortex filaments. Results of computations for three flight conditions are presented for a rotor which is approximately the same as the UH-1A configuration except for assumed differences in pitch control. Author (TAB)

N68-20774# Northrop Corp., Hawthorne, Calif. Norair Div.
V/STOL GROUND-BASED SIMULATION TECHNIQUES Final Report, 27 Jun. 1966–27 May 1967
John B. Sinacori Nov. 1967 73 p refs
(Contract DA-44-177-AMC-462(T))
(NOR-67-85; USAAVLABS-TR-67-55; AD-665425)

A study of various kinds of simulators has been made to determine their capability to produce data representative of visual flight. Four simulations of a jet-lift V/STOL aircraft were conducted using the same pilot. Control characteristics and airframe parameters were maintained constant (as closely as possible), and the same tasks were used by the pilot in each evaluation. The resulting data were compared with flight results from the same aircraft. The simulators used different displays, motion modes, and instrumentation, and the results are discussed in the light of the characteristics of each simulator. The results show clearly that in order to produce quantitative data representative of flight results, the display must have a quality level compatible with the task being performed. Specifically, a precision hovering task requires a high resolution display, while a translation (or transition task) can be performed with a display of much less resolution. The display content is important, particularly for the precision hovering task where height holding is required. For flight simulation of large translational movements, cockpit motion did not appear to affect the results; however, for precision hover and small, quick position changes, cockpit motion appears to be important in that it assists the pilot in detecting small drift and improves his ability to control vehicle attitude. The absence of cockpit motion when using a point source visual display for the presentation of visual information can cause vertigo and loss of performance. Author (TAB)

N68-20829# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
SERVICE LOADINGS OF A MILITARY TRANSPORT AIRPLANE TYPE NORATLAS [BETRIEBSBEANSPRUCHUNGEN EINES TRANSPORT-FLUGZEUGES VOM TYP NORATLAS]
O. Buxbaum 1967 93 p refs In GERMAN; ENGLISH summary
(FB-71(1967)) CFSTI: HC$3.00

Loadings of a Transport Airplane of the German Air Force have been recorded continuously during about 100 flights of normal service operation on the following components and are presented in form of load frequency distributions: Stresses on lower wing, loads on vertical and horizontal tail, bending moments on axle and oleo of a main landing gear, c. g. vertical acceleration. Author

N68-20979# National Research Council of Canada, Ottawa (Ontario).
GROUND DISTRIBUTION CONTOUR MEASUREMENTS FOR FIVE FIRE-BOMBERS CURRENTLY USED IN CANADA
J. I. MacPherson Nov. 1967 74 p ref
(NRC-9997; LR-493) CFSTI: HC$3.00/MF$0.65

A total of 37 contour patterns are presented for five of the major existing fire-bombers currently used in Canada; the Turbo-Beaver, the Otter, the Twin Otter, the TBM Avenger, and the Canso. Pertinent meteorological data, speeds, altitudes, and recovery percentages are included with each contour pattern, and contour lengths and enclosed areas are calculated for each drop distribution. The effects on the ground distribution of using long-term retardant and a water-thickening additive are also discussed. Author

N68-21112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROPOSED ANALYTICAL MODEL FOR THE FINAL STAGES OF LANDING A TRANSPORT AIRPLANE
Maurice D. White Washington Apr. 1968 14 p ref
(NASA-TN-D-4438) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Methods for defining the certifying landing distances and approach speeds of transport airplanes are currently being reviewed. Revisions are being sought that would make the requirements and demonstration procedures account more realistically for operational practices and variables. As an aid in this task, a simple model is proposed for describing the final airborne stages of landing a transport airplane manually. The model separates the maneuver into three distinct phases, an initial flare, a float, and a touchdown. Methods are indicated for estimating the speed changes or lift increments associated with each phase. Assumptions regarding thrust management in the maneuver are shown to be important. The considerations that affect these assumptions are discussed and indicate how the thrust would probably be managed in normal operations. Limited flight data are described which confirm the main elements of the model. Additional refinement of the model is desirable to make it useful in the development of more rational rules for certifying landing characteristics. Author

N68-21116# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVESTIGATION OF LEARNING CURVE AND COST ESTIMATION METHODS FOR CARGO AIRCRAFT
William F. Brockman (M.S. Thesis) and Freddie D. Dickens (M.S. Thesis) Dec. 1967 209 p refs
(GSM/SM/67-2/7; AD-665464)

Learning curves are developed for nine cargo aircraft using log-linear, log-quadratic, and log-cubic forms with best results being obtained with the log-quadratic. Estimating relations for the prediction of new aircraft costs are derived using current methods and tested for accuracy on the original sample and on the C-141A; a cost prediction for the C-5A is also obtained. Predictions were also obtained using a recent RAND Corporation developed equation. Predictive accuracy in all cases was poor and the conclusion was reached that present methods are inadequate for the estimation of direct-labor costs. Author (TAB)

N68-21170# Aeronautical Research Council (Gt. Brit.).
THE PERFORMANCE OF FANS IN HOVERCRAFT. A METHOD OF REDUCING EXPERIMENTAL RESULTS
A. J. Burgess London HMSO 1967 20 p refs Supersedes RAE-TR-65240, ARC-28225 See N67-28071
(ARC-R&M-3507; RAE-TR-65290; ARC-28225)

A method for reducing data on hovercraft fan performance is proposed which is expected to lead to a simplification of model and flight test procedures. The method is shown to be theoretically justified, and supporting experimental evidence is provided from models with both solid and flexible duct geometry. Author (ESRO)

N68-21282# Royal Aircraft Establishment, Farnborough (England).
LOW-SPEED WIND-TUNNEL MEASUREMENTS OF PRESSURE FLUCTUATIONS ON THE WING OF A TWIN-JET AIRCRAFT (BRISTOL 188)
J. A. Lawford and A. R. Beauchamp Dec. 1966 44 p refs
(RAE-TR-66399) CFSTI: $3.00

Root-mean-square intensities and spectra of local pressure fluctuations were measured by transducers at two positions on the inner part of the wing and four on the outer part, while low-frequency pressure fluctuations on the upper surface were obtained at a further positions on the outboard part of the wing by a creeper and transducer. The low-frequency component of pressure and load fluctuations increases in intensity with increasing incidence; on the inboard wing this increase is fairly abrupt and is associated with a change in the form of the mean flow field about the wing; on the outer wing the intensity increases more gradually with incidence. Buffet boundaries have been assessed tentatively from the incidence associated with rapid rise of load fluctuation on the inner wing. Leading-edge strakes may modify the buffet boundaries, giving a gain of about 0.2 in usable C_L trimmed. There is some evidence that leading-dge droop would considerably reduce load fluctuations. Author

N68-21289# Royal Aircraft Establishment, Farnborough (England).
SOME NOTES ON FUEL BOILING LOSSES AND FUEL TANK PRESSURISATION IN A LONG RANGE SUPERSONIC AIRCRAFT
W. G. S. Lester Jun. 1967 23 p refs
(RAE-TR-67137) CFSTI: HC$3.00/MF$0.65

A method of calculating the fuel boiling losses, due to aerodynamic heating from a supersonic aircraft with integral wing fuel tanks is devised and is applied to the Concord, assuming flight conditions of Mach 2.2 to 64000 ft altitude using low boiling point kerosene fuel. It is shown that if the specified tank pump performance is achieved the quantity of fuel evaporated is no more than 150 lb if the tanks are unpressurized, and is negligible in the present design case where the tanks are pressurized to 2.2 psia. The calculations are based on certain assumptions concerning fuel distillation characteristics, heat transfer data, and boiling fuel distribution in the tankage. Because much of the evaporated fuel may condense in the vent system and be recovered it is likely that the fuel loss through boiling in unpressurized tanks will be less than the weight of additional equipment required to pressurize the tanks. Suggestions are made for reducing the severity of the conditions affecting fuel thermal stability by modified fuel handling procedures in the aircraft. Author

N68-21381# Federal Aviation Administration, Washington, D. C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING AERONCA 11: U.S. GENERAL AVIATION 1965
Jul. 1967 13 p
(PB-177103) CFSTI: HC$3.00/MF$0.65

This report contains the briefs of accidents occurring in 1965 involving Aeronca 11 aircraft. There were 16 accidents involving this model aircraft out of a total of 5,196 general aviation accidents in 1965. Author

N68-21370# Federal Aviation Administration, Washington, D. C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING BEECHCRAFT BE-35, BE-35-33 AIRCRAFT: U.S. GENERAL AVIATION 1965
May 1967 89 p
(PB-177104) CFSTI: HC $3.00/MF $0.65

This report contains the briefs of accidents occurring in 1965 involving Beechcraft BE-35, and BE-35-33 aircraft. There were 303 accidents involving this model aircraft out of a total of 5,196 general aviation accidents in 1965. Author

N68-21413*# National Aeronautics and Space Administration, Washington, D. C.
SONIC BOOM RESEARCH
A. R. Seebass, ed. 1967 115 p refs Proc. of NASA Conf. on Res. on the Generation and Propagation of Sonic Booms, Washington, 12 Apr. 1967
(NASA-SP-147) GPO: HC $0.50; CFSTI: MF $0.65 CSCL 01B

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N68-21414*# Princeton Univ., N. J.
BRIEF REVIEW OF THE BASIC THEORY
Wallace D. Hayes *In* NASA, Washington Sonic Boom Res. 1967 p 3–7 refs (See N68-21413 11-02)

Presented is a review of basic theory used to describe the phenomenon of sonic boom. Discussed is the theory of quasilinear geometrical acoustics and existing theories used: (1) to compute local flow field near the aircraft and the associated asymptotic disturbance far from the aircraft; (2) for tracing a sound ray through a nonuniform atmosphere with winds; (3) for calculating the area of a ray tube as it varies along a ray; (4) for calculating an age variable; and (5) in obtaining the signature (using the age variable) after its distortion due to nonlinear effects. S.C.W.

N68-21415*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND ANALYTIC RESEARCH ON SONIC BOOM GENERATION AT NASA
Harry W. Carlson *In its* Sonic Boom Res. 1967 p 9–23 refs (See N68-21413 11-02)

A review of experimental and analytic research on sonic boom generation since 1958 is reported. The nature of sonic boom phenomena is described, and analysis methods used in the prediction of sonic boom are outlined. Examples of the correlation of sonic boom predictions with data from wind tunnel and flight tests are given, and minimization concepts are discussed and illustrated. Important contributions on sonic boom generation in steady level flight are summarized as follows: (1) Basic theory has been verified in wind tunnel tests of simple wings and bodies. (2) The theory has been extended to cover real airplane shapes by the development of numerical methods programmed for use on high speed digital computers. (3) The sonic program and related programs have been made available to the airframe industry and are in widespread use. (5) The general applicability of the prediction methods to airplane steady level flight has been shown to be in correlation with tunnel and flight test data. (5) Minimization concepts have been developed and have been verified in wind tunnel tests. S.C.W.

N68-21416*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC BOOM FLIGHT RESEARCH: SOME EFFECTS OF AIRPLANE OPERATIONS AND THE ATMOSPHERE ON SONIC BOOM SIGNATURES
Domenic J. Maglieri *In its* Sonic Boom Res. 1967 p 25–48 ref (See N68-21413 11-02)

Flight rest results obtained with the aid of small, medium, and large aircraft are presented in an attempt to show the significance of the atmosphere and aircraft operation on sonic boom exposures. A review of research on sonic boom phenomena which focuses on the nature of pressure buildups in the transonic speed range, and with the lateral extent of the pattern in steady flight and quiescent atmospheric conditions; is included. Flight test results indicate that: (1) acceleration and lateral spread phenomena appear to be well understood and predictable for current and future aircraft; (2) variations in the sonic boom signature as a result of the effects of the atmosphere can be expected during routine operations; (3) on the basis of data evaluated, similar variations in pressure signatures are noted for small, medium, and large aircraft; (4) that portion of the atmosphere below about 2000 feet is most influential, although in some cases the higher portions may also be important; (5) aircraft motions, in the form of perturbations about the normal flight track, are shown not to contribute significantly to observed sonic boom signature variations; and (6) for cases where a large number of overpressure data points are available, the average measured values correlate well with current theoretical predictions. S.C.W.

N68-21417*# Boeing Co., Seattle, Wash.
SOME EFFECTS OF THE ATMOSPHERE ON SONIC BOOM
Edward J. Kane *In* NASA, Washington Sonic Boom Res. 1967 p 49–63 refs (See N68-21413 11-02)

Reviewed are results of theoretical and experimental studies on atmospheric influences on sonic boom. Discussed are atmospheric effects as reflected by variations in the following: (1) sonic boom overpressure directly beneath the airplane; (2) lateral distribution of overpressure; and (3) location of lateral cutoff. A theoretical method was developed to predict the influence of stratified nonhomogeneous atmospheres on shock wave propagation. The method was used to study the influence of average and extreme meteorological conditions. Aspects that require additional study are discussed among which include collection and analysis of high altitude, low supersonic Mach number test data, an analytical description of the strength of grazing shock waves, and an investigation of the causes and effects of shock wave turbulence interactions. S.C.W.

N68-21418*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC BOOM EFFECTS ON PEOPLE AND STRUCTURES
Harvey H. Hubbard and William H. Mayes *In its* Sonic Boom Res. 1967 p 65–76 refs (See N68-21413 11-02)

The response of people and structures (buildings) to sonic booms was studied in an effort to determine how such responses will affect community acceptance of overland flights of the supersonic transport. Two different exposure situations for people are analyzed. In one case the person is outdoors and the waves impinge directly on him. In the other case the observer is inside a building structure

and the waves impinge first on the building and the building then acts as a filter which determines the nature of the exposure stimuli reaching the inside observer. Sonic boom induced excitation of buildings arriving through the air which causes them to vibrate are emphasized. Results of these studies indicate that: (1) Outside exposures involve direct impingement of the sonic boom waves on the observer, and in this particular case rise time is a significant factor. (2) If the observer is inside a building, the time durations of the waves may be more important than the exposure stimuli which are largely determined by the structural properties of the building. (3) Such geometric factors as door and window configurations and framing, sheathing, and internal wall arrangement details are noted to be significant. (4) Valid damage incidents reported have been limited to secondary components of buildings, and the rates of occurrence are lower for lower overpressures. S.C.W.

N68-21421# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENT OF AIRCRAFT GROUND RUN SPEED AND DISTANCE USING AN UNCOMPENSATED ACCELEROMETER
C. Higenbottam Nov. 1966 20 p refs
(RAE-TR-66359) CFSTI: HC$3.00/MF$0.65

Trials were carried out in an aircraft to assess the accuracy with which take off speed and distance gone could be measured using a fixed accelerometer. The results indicate that such a source could form the basis of a take off monitor of moderate accuracy provided the aircraft pitch attitude variations were small. Author

N68-21441*# National Aeronautics and Space Administration, Washington, D. C.
ROTORCRAFT
F. Legrand Apr. 1968 467 p refs Transl. into ENGLISH of the Publ. "Giravions" Paris, Ecole Natl. Super. de l'Aeron., 1964 p 1–458
(NASA-TT-F-11530) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A handbook designed to supplement a course on rotorcraft aviation is reported. Three major areas of concentration are emphasized: rotor mechanics; performance; and aerodynamics. Other areas discussed include stability and flight properties; limitations of the helicopter; materials compatibility; component construction (technology); design synthesis; and rotorcraft competitors of the helicopter. S.C.W.

N68-21519# North American Rockwell Corp., Los Angeles. Aerospace and Systems Group.
NEW CONCEPTS FOR EMERGENCY EVACUATION OF TRANSPORT AIRCRAFT FOLLOWING SURVIVABLE ACCIDENTS Final Report
J. A. Roebuck, Jr. Jan. 1968 397 p refs
(Contract FA-67-WA-1766)
(ADS-68-2; AD-665329)

A systems analysis and creative engineering study has resulted in descriptions and theoretical evaluations of 51 new concepts concerning hardware and procedures for improving emergency evacuation of passengers from transport category aircraft following survivable accidents. The concepts are organized into 15 major concepts which are rank ordered in terms of 12 feasibility and economic factors for purposes of selection for experimental evaluation. Requirements for experimental evaluation are presented for the first five major concepts and their specific associated detail concepts, which received the most favorable ratings. Author (TAB)

N68-21639# Hamburger Flugzeugbau G.m.b.H. (West Germany).
POSSIBILITIES FOR CORRECTING FLIGHT MECHANICAL QUALITIES OF AN AIRPLANE IN ITS ADVANCED STAGE OF DEVELOPMENT [MOEGLICHKEITEN DER KORREKTUR FLUGMECHANISCHER EIGENSCHAFTEN EINES FLUGZEUGES IM FORTGESCHRITTENEN PROJEKTSTADIUM]
M. Roederer *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. held by the WGLR Comm. on Aerodyn., on Jul. 10, 1967 in Darmstadt Nov. 1967 p 223–234 (See N68-21633 11-01)

Six examples are given of flight mechanical problems and their correction during the flight test phase of the HFB-320 aircraft. The problems involved insufficient lateral control, excessive lateral forces during single-engine flight, excessive forces on elevator tabs, control stability, and engine stalling. Most of these problems occurred during extreme flight test conditions not encountered in normal flight and were connected with flow separation. Transl. by K.W.

N68-21682# Federal Aviation Administration, Washington, D. C. Dept. of Transportation.
PROCEEDINGS OF A SYMPOSIUM ON PILOT WARNING INSTRUMENTS
Dec. 1967 187 p
(AD-666122)

Contents: Mid-air collision statistics; U. S. Army presentation; U. S. Navy presentation; U. S. Air Force presentation; The use of reduced bandwidth cockpit TV for PWI; NBAA looks at PWI; AOPA position paper; ATA presentation; Air line pilots associations views on PWI; Preliminary status report on feasibility studies of a pilot warning indicator; Open-access C. W. Doppler technique for collision-hazard warning; PWI frequency considerations; Altitude Rho/theta pilot warning instrument; Infrared studies; Sperry Gyroscope Company experiments; Current and future programs in PWI; PWI bibliography list; COPAG PWI characteristics working paper; Advisory Circular, AC 00-23, near midair collision study. TAB

N68-21739# Vitro Labs., Silver Spring, Md.
FLIGHT CONTROL SYSTEMS AND LAUNCHING TECHNIQUES FOR AIR BALLAST SYSTEMS Scientific Report
Allen R. Davidson, Jr. 6 Nov. 1967 77 p refs
(Contract F19628-67-C-0192)
(TN-02057.02-2; SR-2; AFCRL-67-0679; AD-666446)

This report examines some of the more practical aspects in the application of air ballast systems to the control of free-flight balloons. Each type of air ballast system, as defined in Scientific Report No. 1, is analyzed for the cost, availability of materials, components, and instrumentation required. In addition, for each type of air ballast system deemed feasible, the possible flight system configurations, associated launching problems, and methods to solve the problems are investigated. It is the conclusion of this report that most air ballast systems can be instrumented and flown with conventional or off-the-shelf components and equipment. Systems using very large payloads are more difficult to handle and launch than smaller payload systems and probably will require some development in new launching techniques and associated equipment. Author (TAB)

N68-21772# Ryan Aeronautical Co., San Diego, Calif.
FLEXIBLE WING TOWED UNIVERSAL GLIDER Final Report, 7 Oct. 1964–2 Nov. 1965
Oct. 1967 151 p refs
(Contract DA-44-177-AMC-179(T); ARPA Order 294)
(Rept.-29267-1; USAAVLABS-TR-67-57; AD-666248)

The report concerns the design, fabrication, and test of a flexible wing towed universal glider. The purpose of the glider design was to develop an unpowered, roadable, winged vehicle which could carry up to 4000 pounds of payload on an open bed which would put minimum restrictions on cargo volume and shape. The vehicle towed by a helicopter would extend the normal helicopter internal load and slingload capacity as well as place hazardous cargo remote from the helicopter and crew. Author (TAB)

N68-21779# Federal Aviation Administration, Washington, D. C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING AERONCA 7 AIRCRAFT: U. S. GENERAL AVIATION 1965
May 1967 57 p
(PB-177102)

This report contains the Briefs of Accidents involving Aeronca 7 aircraft occurring in 1965. There were 181 accidents involving this model aircraft out of a total of 5,196 general aviation accidents in 1965. Author

N68-21788# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
CALCULATION OF EJECTION SEAT TRAJECTORIES [BERECHNUNG VON SCHLEUDERSITZBAHNEN]
Rudolf Ludwig Dec. 1967 61 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-90) CFSTI: HC $3.00/MF $0.65

The equations of motion are set up for an ejection seat system and are numerically evaluated. The trajectories relative to the aircraft which are obtained by variation of the most important trajectory parameters are discussed. In this, only that part of the trajectory is considered in which the ejection seat flies freely after release from the aircraft, without the influence of stabilization or braking devices. Besides the calculations in which wind tunnel measurements (3 components) are taken as a base for aerodynamics, approximate calculations have been carried out which lead to analytical results under the assumption of constant drag and linearization of the equations of motion. Author

N68-21793# Royal Aircraft Establishment, Farnborough (England).
SOME ASPECTS OF THE ASSESSMENT OF V/STOL MILITARY TRANSPORT AIRCRAFT
J. Williams and J. F. Holford Sep. 1966 41 p
(RAE-TR-66302) CFSTI: HC $3.00/MF $0.65

The primary concepts of the various VTOL schemes now available for practical aircraft application are first briefly compared and STOL aspects mentioned. The particular example of jet-lift VTOL military transport is discussed in more detail, the special design considerations and problem areas being noted to facilitate realistic assessment. The effects of variation in design mission on the aircraft size and relative cost are especially considered, together with the sensitivity of performance to possible errors in design assumptions or changes in operational requirements. Some operational attractions of VTOL capability in relation to military transport aircraft besides helicopters are illustrated, emphasising that such aircraft must not be assessed in isolation but by cost-effectiveness studies for a complete transport system. Author

N68-21794# Royal Aircraft Establishment, Farnborough (England).
GRADIENT PROPERTIES OF A MODEL OF STATIONARY RANDOM TURBULENCE
J. G. Jones Jun. 1967 29 p refs
(RAE-TR-67134) CFSTI: HC $3.00/MF $0.65

Histograms for changes in turbulence velocity over given distances are presented, based on a standard power spectral model. It is proposed that these be used as the basis of a comparison between the gradient properties of the model and the measured gradient properties of samples of atmospheric turbulence. An application of the histograms to the gust response of an aircraft with an autothrottle is described. Author

N68-21834*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY MEASURED AND PREDICTED XB-70 ENGINE NOISE
Paul L. Lasagna and Norman J. Mc Leod Washington Apr. 1968 21 p refs
(NASA-TM-X-1565) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Noise measurements on the ground were made during takeoffs, a landing, and a flyby of the XB-70 airplane. Noise predictions made by using the SAE method differed from the measured levels. The substitution of standard-day atmosphere for actual atmosphere improved the comparison of the measured and predicted noise spectra. Further investigation is needed to determine the reasons for the difference between the measured and the predicted levels. Perceived noise levels of the XB-70 were approximately 7 PNdB to 10 PNdB higher than the maximum overall sound-pressure levels in decibels. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-20716# Eagle-Picher Co., Joplin, Mo. Electronics Div.
DEVELOPMENT OF THE HARP BATTERY Final Report
Edward P. Broglio Dec. 1967 70 p
(Contract DA-49-186-AMC-295(X))
(NA-167; HDL-295-F; AD-665409)

The development of a miniature sealed silver-zinc rechargeable battery for high altitude research program is outlined. Details concerning the selection of the successful design concept are presented. The evolution of the battery case design is presented in detail along with the design parameters for the active battery components. The solution of design problems both mechanical and electrical performance is outlined. The report contains operating and charging instructions for the battery, typical performance characteristics and drawings. Author (TAB)

N68-20745# Sonotone Corp., Elmsford, N. Y.
OPTIMUM STRUCTURES FOR MINIATURE Ni–Cd SEALED CELLS AND BATTERIES Quarterly Report, 11 Feb.–10 Oct. 1967
Stephan Thornell and John Pivarnik Dec. 1967 75 p
(Contract DA-28-043-AMC-02361(E))
(ECOM-02361-3; QR-3; AD-665443)

The report covers the research and development activities which have been directed towards the optimum structural design of miniature Ni-Cd cells and 6-volt batteries. Information covers an analysis of volumetric efficiency, weight distribution, stress on case, and plate structures. Results include data on various additives to sintered and pasted plates: didymium nitrate, cobalt nitrate; effects of cycling positive plates in carbonate electrolyte; effects of nickel and graphite additives to negative plates; evaluation of K60 and K90 cells after 1008 cycles at C/5 charge rate; cell pressures with pasted negative plates; numerous charge-discharge graphs and other supporting data. Author (TAB)

N68-20832*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIATION MAPPING OF A PLANETARY SURFACE LANDER SYSTEM
P. J. Gingo 15 Apr. 1968 24 p refs
(Contract NAS7-100)
(NASA-CR-93919; JPL-TR-32-1252) CFSTI: HC $3.00/MF $0.65 CSCL 10B

This report describes the radiation mapping analysis of a capsule lander system with three radioisotope thermoelectric generators for advanced space missions. The integration analysis, with the

geometric model used to provide the radiation map, defines the radiation field produced by the power generators including the deorbit motor. Statistical data and graphs of the gamma dose rate and neutron flux provide the radiation intensities at numerous detection points to completely map the regions for the power generators and motor. These radiation intensity variances dictate careful location of each scientific instrument based on individual instrument characteristics. Author

N68-20884# Pratt and Whitney Aircraft, East Hartford, Conn.
FIVE HUNDRED-WATT INDIRECT HYDROCARBON-AIR FUEL CELL SYSTEMS Midterm Report, 10 Apr.–9 Sep. 1967
Calvin D. Greenwood Feb. 1968 47 p
(Contract DAAB07-67-C-0376)
(PWA-3211; ECOM-0376-1; AD-665435)

Work was undertaken to design, fabricate, test, and deliver two man-portable, 500-watt, indirect liquid hydrocarbon-air fuel cell powerplants. Studies showed that use of a boost pump would enable operation from a remote fuel source. Incorporation of a desulfurizer permits use of JP-4 or CITE. Automatic sequencing and control in both the hydrogen generator and the fuel cell assembly are activated from a single manual input signal; automatic shut-down occurs when off-design conditions are sensed. The units are being designed for compactness, minimum weight and sustained operation under Army field conditions. Incorporation of heat exchangers and a fan in the water recovery unit permits recovery of water from the exhaust gases of the hydrogen generator and fuel cell stack. Preliminary studies and breadboard simulation have indicated the feasibility of a design which meets these requirements. Author (TAB)

N68-20895 Australian National Univ., Canberra. Dept. of Engineering Physics.
NOTES ON SPEED BALANCE CONTROLS ON THE CANBERRA HOMOPOLAR GENERATOR
T. W. Brady Apr. 1967 23 p refs
(EP-RR-8)

The two 40-ton rotors of the Canberra Homopolar Generator, which are independently mounted, tend to run at different speeds for various reasons. Satisfactory operation of the generator demands that the speed of the two rotors be synchronized, or balanced. This paper shows how this aim was achieved by a simple but effective servo of the ON-OFF type. This servo employs a contactor-clutch arrangement of simple design, which has an unusual phase advance characteristic. Author

N68-20924 Australian National Univ., Canberra. Dept. of Engineering Physics.
A STUDY OF THE PERFORMANCE OF THE 1000 KW MOTOR GENERATOR SET SUPPLYING THE CANBERRA HOMOPOLAR GENERATOR FIELD
T. W. Brady Apr. 1967 23 p refs
(EP-RR-10)

Safety studies are described on the 1000 kW motor generator set used for exciting the field magnet of the Homopolar Generator. The studies were made by tests on the set and analog simulation of its behavior. In some cases, analog studies were first made on the results checked by tests; these gave confidence that the analog simulation was in fact reliable. No attempts were made to deal with commonplace faults, such as a partial or complete short circuit on the set, because the protective apparatus in the switch-gear should handle them. Author

N68-20936# Naval Ordnance Lab., White Oak, Md.
THE CONTROL OF INSOLUBLE MAGNESIUM COMPOUNDS RESULTING FROM SEA WATER BATTERY OPERATION
Carl E. Mueller and Frederic M. Bowers 18 Dec. 1967 25 p refs
(NOLTR-67-120; AD-665488)

The capacity of low rate multicell silver chloride/magnesium sea water batteries is often limited by a flocculent precipitate that clogs the inlet ports and fills the space between the electrodes. The results of this investigation show that the flocculent precipitate is formed only when magnesium ions ($Mg(++)$) are initially present in the electrolyte solution. In magnesium free salt solutions, with a salinity equal to sea water, the precipitate is granular. The magnesium-ion effect can be controlled by passing the incoming sea water electrolyte through a filter of thallous fluoride (TIF) or disodium ethylenediaminetetraacetate (disodium EDTA). The magnesium ions in the sea water electrolyte apparently react with the TIF to form a granular precipitate, and with disodium EDTA to form a soluble magnesium complex. Batteries containing filters of these types were discharged in 3.5% salinity sea water and showed capacity increases ranging from 12 to 60 percent over batteries having no filter. With TIF filters the capacity increase was typically 12 percent and with disodium EDTA the increase was typically 45 percent. Author (TAB)

N68-20941 Australian National Univ., Canberra. Dept. of Engineering Physics.
TESTS ON THE CANBERRA HOMOPOLAR GENERATOR ARRANGED TO SUPPLY THE 5 MEGAWATT MAGNET
E. K. Inall Apr. 1967 15 p refs
(EP-RR-9)

The homopolar generator was designed to deliver pulses of current rising to 1.6×10^6 amp in 0.7 seconds, and immediately dropping to zero again in about 0.8 seconds. The thermal inertia of many components was designed to limit the temperature rise due to losses in them to safe values. When the generator is used to supply 25,000 amp for 30 to 60 seconds in a magnet, fewer brushes are used in parallel at each contact with the rotors than for the high current pulses. These tests showed that no parts of the generator overheated when used in this way. Author

N68-20942 Australian National Univ., Canberra. Dept. of Engineering Physics.
LIMITATIONS OF RATE OF RISE OF PULSE CURRENT IMPOSED BY SKIN EFFECTS IN ROTORS
P. O. Carden Apr. 1967 25 p refs
(EP-RR-2)

The problem of skin effect in the steel rotors of the fast-discharge Canberra Homopolar Generator is analyzed, particular attention being given to rotor heating. It is shown that the maximum possible temperature rise occurs at the surface and is practically proportional to the homopolar current during the rising part of a discharge with constant rise rate. It is concluded that for the Canberra machine, surface heating is insignificant no matter how fast the rise time. Author

N68-20944*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECTS OF SOLAR PROTON FLARES ON THE POWER OUTPUT OF SOLAR CELLS HAVING VARIOUS CONFIGURATIONS
Paul Berman 15 Feb. 1968 18 p refs
(Contract NAS7-100)
(NASA-CR-93922; JPL-TR-32-1251) CFSTI: HC $3.00/MF $0.65 CSCL 10A

In designing a photovoltaic power system for deep space missions it is necessary to allow for degradation of the electrical output caused by exposure to solar proton flares. A technique for predicting the degradation of solar-cell power output for P/N and N/P silicon solar cells for two solar flare models is presented. The results of an experiment conducted to test the validity of the technique are also presented. The proton energies of 36, 100, and 137 MeV were used in the experiment. For protons of these

energy levels, at a fluence of 2×10^{10} protons/cm^2, the only measurable electrical degradation occurred in the solar cell and not in the coverglass or coverglass adhesive. In general, the predictions were in reasonable agreement with the experimentally observed electrical degradations, but were pessimistic by approximately 6 to 9 and 3 to 6% for P/N and N/P cells, respectively. Some possible explanations for these discrepancies are given. Author

N68-20959# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
SEPARATORS FOR HIGH-RATE, NON-RESERVE ZINC–SILVER OXIDE BATTERIES Final Report, 20 Feb.–19 Nov. 1967
A. Himy Jan. 1968 115 p refs
(Contract DAAB07-67-C-0310)
(DAC-59852-F; Rept.-2; ECOM-0310-F; AD-665631)

The purpose of the program was to investigate separator materials for high rate, nonreserve, zinc-silver oxide batteries for obtaining a readily producible film. Emphasis was placed on selecting an optimum inorganic material and formulating several inorganic-organic composites, accompanied by a series of evaluations designed to satisfy the requirements outlined above. Finally, the most favorable systems were subjected to actual cell tests to complete the evaluation. The report provides a description of the results obtained during the course of the program. Separator mechanistic interpretations are also presented and experimental procedures are described. TAB

N68-21035*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
[RESEARCH IN THE CONVERSION OF VARIOUS FORMS OF ENERGY BY UNCONVENTIONAL TECHNIQUES] Status Report
Manfred Altman Dec. 1967 105 p refs
(Grant NSG-316)
(NASA-CR-93979; INDEC-SR-13) CFSTI: HC $3.00/MF $0.65 CSCL 10A

CONTENTS:

1. MATERIALS ENGINEERING M. Altman, S. Pollack, and L. Girifalco 9 p refs (See N68-21036 11-33)
2. PLASMA ENGINEERING S. Pollack, G. Schrenk, S. Schweitzer, and H. Yeh 5 p (See N68-21037 11-23)
3. ELECTROCHEMICAL ENGINEERING L. Nanis, J. O. M. Bockris, and P. Javet 9 p refs (See N68-21038 11-03)

APPENDIXES

4. THERMAL DIFFUSIVITY OF LIQUIDS Manfred Altman and K. Sreenivasan 14 p refs
5. SUPERCONDUCTIVITY IN EVAPORATED TUNGSTEN FILMS S. Basavaiah and S. R. Pollack 8 p refs
6. STUDIES OF THERMAL TRANSPIRATION FOR THE DEVELOPMENT OF A "THERMAL PUMP" Manfred Altman and E. Hopfinger 16 p refs
7. OVERPOTENTIAL TRANSIENTS ON THE ROTATING DISK L. Nanis and Irving Klein 3 p
8. CURRENT AND POTENTIAL DISTRIBUTION IN CYLINDRICAL GEOMETRIES: ENGINEERING APPLICATION TO FUEL CELL DESIGN L. Nanis and Wallace Kesselman 5 p refs
9. FOAMING ELECTROLYTE FUEL CELL L. Nanis and A. P. Saunders 4 p
10. ATOMIC SCALE ELECTRODE PROCESSES: EXCHANGE CURRENT DENSITY ON IRIDIUM P. Javet and L. Nanis 7 p refs
11. PRIMARY AND SECONDARY CELLS USING CHARGE TRANSFER COMPLEXES 7 p refs

N68-21038*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
ELECTROCHEMICAL ENGINEERING
Leonard Nanis, John O'M. Bockris, and Philippe Javet *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Dec. 1967 9 p refs (See N68-21035 11-03)

Progress is reported on several electrochemical engineering studies concerned with overpotential transients on the rotating disk, current and potential distribution in cylindrical geometries, a foaming electrolyte fuel cell, atomic scale electrode processes, primary and secondary cells using charge transfer complexes, and a boiling fuel cell. A mathematical model was constructed for the transient redox overpotential decaying from steady state following interruption of galvanostatic conditions. An intermediate case of current distribution lying between primary and uniform was solved for a linear relation between current density and electrode overpotential. The role of oxygen traces in triggering the potential instability between the hydrogen reduction and oxygen evolution region was determined using helium gas purging in the cathode compartment of the foaming electrolyte fuel cells. The rearrangement of surface atoms induced on a field ion microscope tip by immersion into dilute Ir-ion solution was studied. R.N.A.

N68-21042# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
LIQUID-METAL-HEATED STEAM GENERATOR OPERATING EXPERIENCE
G. S. Budney 1 Nov. 1967 168 p refs
(Contract AT(04-3)-700)
(NAA-SR-12534) CFSTI: HC $3.00/MF $0.65

The operating experience of liquid-metal-heated steam generators applicable to liquid-metal-cooled fast breeder reactor power plants is presented. The steam generators reviewed are those tested under the SIR program, small-scale steam generators tested in support of experimental and prototype nuclear power plants, the experimental and prototype nuclear plant units, and the model steam generators to be tested in the Sodium Components Test Installation (SCTI). The materials, design, and operating characteristics are described with emphasis on those features that affect the structural integrity of the steam generators. The failures that have occurred are described and the probable cause of failure and solution are discussed. NSA

N68-21049 Australian National Univ., Canberra. Dept. of Engineering Physics.
PROVING TESTS ON THE CANBERRA HOMOPOLAR GENERATOR WITH THE TWO ROTORS CONNECTED IN SERIES
E. K. Inall Apr. 1967 37 p refs
(EP-RR-7)

The rise in the temperature of the surface of the rotor due to its passage under the pulse brushes was measured. At 500 rpm and a current of 1.5×10^6A a rise and fall of 30°C was observed twice per revolution at any point on the rotor surface, as it passed under two brush blocks in succession, that is, under 24 brushes each one centimeter wide. The lower value of this temperature fluctuation was 40°C above the ambient temperature of the rotor. Movements of the rotor during current pulses were measured in the axial and transverse directions and tilting. The performance of the pulse current brushes and motoring brushes was examined, and the effectiveness of a simple modification to stop the development of "black" brushes was demonstrated. The operation of the variable electrolytic resistor used as the load on the generator proved satisfactory even at high voltages. The voltage drop across the contact between the slip ring and the rotor was measured. The value proved that the contact to the top rotor was very good, and that the lower rotor satisfactory. Author

N68-21051# Northeastern Univ., Boston, Mass. Photochemistry and Spectroscopy Lab.
RESEARCH IN ENERGY CONVERSION Final Report, 1 Oct. 1963–30 Sep. 1966

Welville B. Nowak, Karl Weiss, and Robert N. Wiener 30 Sep. 1966 686 p refs
(Contract AF 19(628)-3836)
(AFCRL-67-0512; AD-665484)

CONTENTS:

1. INVESTIGATIONS IN THERMIONIC AND PHOTOVOLTAIC ENERGY CONVERSION p 1–165 refs (See N68-21052 11-03)

2. PHOTOCHEMICAL STUDIES OF MOLECULAR SYSTEMS p 166–490 refs (See N68-21053 11-06)

3. INVESTIGATION OF NITROGEN-SULFUR SYSTEMS R. N. Wiener, L. I. Rubin, and S. N. Singh p 491–588 refs (See N68-21054 11-06)

N68-21052# Northeastern Univ., Boston, Mass.
INVESTIGATIONS IN THERMIONIC AND PHOTOVOLTAIC ENERGY CONVERSION
In its Res. in Energy Conversion 30 Sep. 1966 p 1–165 refs (See N68-21051 11-03)

Reported are results of studies on thermionic and photovoltaic energy conversion among which are cited studies of the response characteristics of silicon solar cells, the silicon single crystal film fabrication, energy conversion applications of hetero-junction diodes, thermodynamic aspects of photovoltaic devices, the properties of cathodes, and diffusion effects in silicon. S.C.W.

N68-21055# Union Carbide Corp., Parma, Ohio. Technical Center.
EXPLORATORY DEVELOPMENT MODEL MINIATURE HYDROGEN GENERATOR Final Report, 1 Nov. 1966–31 Oct. 1967
Jack E. Rothfleisch Feb. 1968 66 p
(Contract DAAB07-67-C-0114)
(Rept.-2; ECOM-0114-F; AD-665635)

Two exploratory development model miniature hydrogen generators were designed, fabricated, tested, and delivered to the United States Army Electronics Command. The two units are fully operative generator systems designed to produce sufficient hydrogen by thermal cracking JP-4 jet fuel to supply 200-watt hydrogen/air fuel cell systems for intermittent twelve-hour operating periods. Qualification tests of the completed systems demonstrated the technical feasibility of man-portable generators based on the thermal cracking principle, and indicated that fully qualified, reliable field units can be developed without any major technological advances. Author (TAB)

N68-21098# European Space Technology Center, Noordwijk (Netherlands).
BALLOON FLIGHT EXPERIMENT FOR CALIBRATION OF SOLAR CELLS
K. H. David and A. W. Prevkschat Paris ESRO Oct. 1967 36 p refs
(ESRO-TN-18) CFSTI: HC$3.00/MF$0.65

A balloon-borne experiment for the calibration of solar cells with respect to short-circuit current and open-circuit voltage at AMO (air mass zero) sunlight is described. In addition, a number of N on P silicon solar cells, CdS thin film solar cells, and silicon cells which had been subjected to two levels of electron irradiation were calibrated. The effect of atmospheric attenuation at a height of 25 km on the short-circuit current could be determined. Depending on the relative spectral response of the cells, atmospheric attenuation ranged from 1.28% to 1.9% per unit relative air mass at that altitude. Temperature coefficients of open-circuit voltage and short-circuit current, under AMO conditions, were determined over the temperature range from 15°C to 50°C. Author (ESRO)

N68-21120# Argonne National Lab., Ill.
REDUCTION OF ELECTRICAL END LOSSES IN MHD GENERATOR CHANNELS BY INSULATING VANES
Jerzy R. Moszynski Sep. 1967 29 p refs
(Contract W-31-109-ENG-38)
(ANL-7188) CFSTI: HC$3.00/MF$0.65

A conducting-paper analog study was made of the effectiveness of various vane configurations in reducing electrical end losses. The applicability of established friction-loss correlations to vaned channel geometries was studied. Also an evaluation was made of multiple-vane configurations in terms of their influence of both electrical and friction losses. This evaluation led to selection of a vane configuration capable of reducing the electrical end losses significantly, with only minor increases in friction losses. NSA

N68-21127# Sundstrand Corp., Rockford, Ill. Aviation Div.
ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM Quarterly Progress Report, 1 Jul.–1 Oct. 1967
Warren A. Adam 15 Oct. 1967 53 p
(Contract AT(04-3)-651)
(SAN-651-43; QPR-6) CFSTI: HC$3.00/MF$0.65

The working fluids biphenyl and the eutectic mixture of biphenyl and biphenyl ether were investigated for use in an organic rankine cycle power conversion system capable of long operation in a space environment. The program tasks are the investigation of the working fluid, bearings, condensate pumps, and boilers. A loop containing the eutectic has run for 1642 hrs. A loop containing biphenyl operated 1026 hours when a leak occurred. Fluid which was lost was replaced and the loop restarted. Another loop containing biphenyl has run for 2200 hrs. Both biphenyl and the eutectic have shown excellent thermal stability. The bearing test rig was designed and is being fabricated. Bearings are being fabricated. All components of the pump test rig and test loop are on order or have been received. One pump to be tested has been delivered. All major hardware for the boiler test loop has been received and the assembly is over 50% complete. NSA

N68-21147# Geoscience, Ltd., Solana Beach, Calif.
INVESTIGATION OF FUNDAMENTAL MECHANISMS AND PARAMETERS THAT INFLUENCE STEADY STATE AND TRANSIENT PERFORMANCE OF RANKINE CYCLE LIQUID METAL SYSTEMS Quarterly Report, 1 Jul.–30 Sep. 1967
H. F. Poppendiek, N. D. Greene, C. M. Sabin, and W. B. Goddard 30 Sep. 1967 28 p refs
(Contract AT(04-3)-677)
(GLR-58; SAN-677-19) CFSTI: HC$3.00/MF$0.65

Research activities on phase distributions in forced flow boiling applicable to Rankine cycle systems are described. A Freon 11 boiling system was modified and used to evaluate the problems in forced flow phase distribution photography. Pressures, temperatures and flow velocities were measured with this system. Preliminary photographs of rapidly moving mercury droplets were obtained. Two analytical studies relating to phase distribution in a boiler tube were made. One analysis consisted of the prediction of the velocities of liquid drops located at the boiler tube wall under both direct contact and film boiling conditions; radial variations of the vapor velocities in the two phase system were also included. Additional calculations were made for the dynamics of oscillating drops; information on the oscillation period and average heat transfer is presented. Author (NSA)

N68-21211# Argonne National Lab., Ill. Reactor Physics Div.
EXPERIMENTAL INVESTIGATION OF LOW-PRESSURE ALKALI-METAL THERMIONIC CONVERTERS FOR DC AND RF POWER
Hans K. Richards Sep. 1967 72 p refs
(Contract W-31-109-ENG-38)
(ANL-7377) CFSTI: HC$3.00/MF$0.65

Experiments with a low-pressure thermionic converter have been conducted with cesium, potassium, and sodium metal vapors. These metals provided for the neutralization of the electron space charge and the reduction of the collector work function. A tantalum

emitter was brought to the desired temperature by electron bombardment. A molybdenum collector and guard ring were situated opposit the collector. The emitter–collector distance could be varied several millimeters by means of a micrometer control. The investigation included the dc electron current, output voltage, and power as a function of emitter temperature, vapor pressure, emitter–collector distance and effect of the different alkali metals. Covered in the investigation was the production of high-frequency oscillations (rf). The frequency, rms voltage, and power output were reported in detail as functions of the dc collector voltage, emitter temperature, emitter–collector distance, vapor pressure, and alkali metal. In addition, a dc–rf interaction was observed and analyzed.
Author (NSA)

N68-21309# Thermo Electron Engineering Corp., Waltham, Mass.
VACUUM FOIL-TYPE THERMAL INSULATION FOR RADIOISOTOPE POWER SYSTEMS, PHASE 1 Final Report, Feb. 8, 1966–Aug. 8, 1967
J. B. Dunlay, J. Fronduto, M. L. Paquin, V. L. Poirier, and L. van Someren 8 Aug. 1967 250 p
(Contract AT(30-1)-3634)
(ALO-3634-6) CFSTI: HC$3.00/MF$0.65

Compatibility tests identified insulation material combinations acceptable for operation at 1700 and 1900°C. The tungsten–thoria and tungsten 25% rhenium alloy–thoria combinations were satisfactory at 1700°C for the entire 2000 hour test period, and at 1900°C for 500 hours. Heat flux measurements were made on planar and cylindrical test samples. The molybdenum–thoria combination outperformed other insulation samples. Insulation performance was measured as a function of applied compressive loads and the accumulated total hours of operation. An analytical and experimental effort evaluated insulation corner designs. The heat loss per unit length of edge was measured as a function of source temperature for three corner configurations. The thermal losses associated with two types of structural support insulation were measured. Preliminary designs were developed for a static structure test assembly and an insulation demonstration system.
Author (NSA)

N68-21327# Army Electronics Labs., Fort Monmouth, N. J. Power Sources Div.
FUEL CELLS Status Report, No. 6
Galen R. Frysinger May 1967 181 p refs
(ECOM-2915; AD-665353)

A major portion of the document is devoted to a consideration of initial military applications for fuel cells, a critical analysis and opinion as to the state of the art in achieving these applications, and a discussion of some of the problem areas associated with more widespread use of fuel cell systems. Specific attention is given to the classes of Army application for fuel cell power sources, assessing the attractiveness of these fuel cell power sources as compared to other possible advanced power source or energy conversion systems where this is applicable, and as far as possible to state an opinion of the specific problems which must be overcome to obtain technical feasibility and practicality. A topical discussion is given of several key areas in which it is felt that the status should be reviewed in a little more detail. Throughout the course of the various experimental investigations which have been sponsored in the name of fuel cell research, many new experimental techniques have been devised for studying electrochemical reactions. A few of these are summarized and their ability to help answer still unsolved problems is considered. The last section of the report reviews the significant fuel cell endeavors in France, the Netherlands, and Japan.
TAB

N68-21331# Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik.
APPLIED MAGNETOHYDRODYNAMICS, NO. 3 [ANGEWANDTE MAGNETOHYDRODYNAMIK, HEFT 3]
T. Bohn, S. Foerster, K. Grawatsch, Chr. Holzapfel, G. Kolb et al Dec. 1967 75 p refs In GERMAN
(JUL-510-TP) CFSTI: HC$3.00/MF$0.65

This paper describes design and construction of the ARGAS experimental magnetohydrodynamic generator at this nuclear research facility. The argon-operated generator is used to study the factors affecting specific energy conversion and the properties of dense, weakly ionized gases in general. Experiments with helium and neon as the operating gas are also considered. A detailed description is given of generator layout, heater elements, jet with diffuser and magnet, heat exchanger, cesium loop, compressors, gas purifiers, control arrangements, and instrumentation.
Transl. by K.W.

N68-21371# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
BUILDING A BLANKING GENERATOR FOR THE BENDIX MULTIPLIER M-105 G6 IN FLIGHT TIME MASS SPECTROMETER [BAU EINES LOESCHGENERATORS FUER DEN BENDIX-MULTIPLIER M-105-G6 IM FLUGZEITMASSENSPEKTROMETER]
W. H. Petrick, J.-P. Pfeifer, and R. N. Schindler Dec. 1967 23 p In GERMAN
(JUL-507-PC) CFSTI: HC$3.00/MF$0.65

Mechanical and electronic construction, circuitry, packaging, and operation of the blanking generator are described and illustrated. Used with the Bendix multiplier and a time-of-flight mass spectrometer, the 300 V pulses of the generator quench selected parts of the mass spectrum by preventing the entry of secondary electrons into the multiplier system. The generator is used when weak peaks are registered alongside of intensive bands, such as occur in the direct mass-spectrometric analysis of separate samples in gas chromatography.
Transl. by K.W.

N68-21401*# TRW Equipment Labs., Cleveland, Ohio.
CONTINUED DEVELOPMENT OF A HYPERGOLIC ELECTRICAL POWER SYSTEM Final Report, Apr. 1966–Jan. 1967
Mar. 1968 252 p refs
(Contract NAS9-6879)
(NASA-CR-92043; ER-7249) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Efforts are summarized for the second phase in the development of a hypergolic turboalternator flight-type power system to complement the lunar module electrical power system and extend lunar stay time. Both component and flight system development as well as two 100-hour system endurance tests are described. Attention is given to system design changes that involve the gas generator, turbine, alternator housing, inlet scroll, bellows seal, controls and power conditioning, and lubrication and cooling system. The facility for the testing program is considered; and details are included for the component, turboalternator performance, flight system endurance, and vibration tests. A test log for the 177 tests performed is appended.
M.W.R.

N68-21439# General Electric Co., New York. Research and Development Center.
FUEL CELLS WITH MOLTEN-CARBONATE ELECTROLYTES
H. A. Liebhafsky and E. J. Cairns Jun. 1967 40 p refs
(Rept.-67-C-210)

Research efforts related to molten carbonate fuel cells are summarized by highlighting the work of several investigators, considering both aqueous and nonaqueous electrolytes, and predicting the future for practical batteries. It is noted that the great importance of natural gas has added significantly to the study of such fuel cells; and that with regard to power output, attainable gas utilization, and cell operating life, there appears to be a future for the high temperature fused carbonate cell. Economic feasibility of such batteries can be determined by conducting larger scale studies than are presently underway.
M.W.R.

N68-21489# Burgess Battery Co., Freeport, Ill.
MAGNESIUM ROUND DRY CELL BATTERIES Final Report, 1 Jul. 1966–30 Jun. 1967
Terry G. Messing Feb. 1968 79 p
(Contract DA-28-043-AMC-02572(E))
(Rept.-1; ECOM-02572-F; AD-666184)

Discussion of the development of a magnesium dry cell with a mechanical seal is given. Data is shown describing this cell's delay time characteristics and capacities after extended periods of storage. Use of certain measuring circuits to give a nondestructive test of a magnesium cell is shown. Author (TAB)

N68-21562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRITICAL ELECTRICAL ASPECTS OF ALTERNATING-CURRENT POWER SOURCE FOR CENTAUR SPACE VEHICLE
Maurice F. Baddour and John P. Quitter Washington Apr. 1968 36 p
(NASA-TM-X-1569) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A solid-state inverter is used on Centaur to supply high-quality three-phase electric power to the guidance, autopilot, and propellant utilization systems. (Centaur is a high-energy, cryogenic-fueled second-stage vehicle.) The results of a test program to evaluate the design and performance of this inverter are described. The scope of the program is concerned primarily with measurements on internal parts of the inverter while it was subjected to extreme service conditions. Detailed data are presented on electrical and thermal design margins. Special attention is directed toward transient susceptibility and the effect of source impedance variations. Significant wave shapes are shown, and their implications are examined. Test failures and critical weaknesses in the system are analyzed, and design improvements are proposed. These improvements were incorporated into the inverter and verified by test. Subsequent flight performance has been excellent, and the inverter has provided three-phase electric power of high quality at 400 hertz to the Atlas-Centaur launch vehicle on 14 flights. Author

N68-21597*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONIC CONVERTER AND GENERATOR TESTS
P. Rouklove 1 Mar. 1968 15 p refs
(Contract NAS7-100)
(NASA-CR-94154; JPL-TR-32-1244) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The results of tests of approximately 40 advanced-technology thermionic converters (all of planar geometry) and of 2 thermionic generators are presented, which were made to determine power output, maximum life, efficiency, and ability to withstand environmental stresses. Electron bombardment was used to simulate solar heating. In support of the converter and generator development ancillary experiments were performed to investigate (1) the reaction of alumina with molybdenum at high temperatures, (2) the accuracy of temperature measurements with different types of hohlraums with various L/D ratios, (3) the effects on the performance of a converter when enclosed in a generator configuration, and (4) the relationship between the shape of the emitter and that of the filaments used in the electron bombardment. Improved test equipment enabled simpler operation and, also, provided greater accuracy in diagnostic measurements. It was demonstrated that the units assembled have increased power and long-term life and can stand the stresses of the Atlas/Agena launch environment. Author

N68-21602# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
FABRICATION OF CADMIUM SULFIDE THIN FILM SOLAR CELLS FOR SPACE VEHICLE TESTING Final Scientific Report, 1 Sep. 1965–15 Aug. 1967
H. E. Nastelin, J. R. Hietanen, and F. A. Shirland Wright-Patterson AFB, Ohio ARL Dec. 1967 48 p refs
(Contract AF 33(615)-3253)
(ARL-67-0282; Rept.-303280; AD-666439)

Five series of flight panels for satellite and balloon flight testing were prepared. Panels AR-1 through 6 were delivered to APL in September of 1965. Panels AR-8 through 10, of similar fabrication, were delivered in March of 1966. Panels ARX-701-1 through 4 were delivered in April of 1967 for inclusion in the OV1-13 satellite experiment. Three balloon flight modules, AFAPL-CdS-1, -2, and -3, were delivered to APL in May of 1966, and three additional balloon flight modules, AFAPL-CdS-005, 006, 007, were delivered in May of 1967, both for JPL balloon flight experiments. Work was performed on increasing the efficiency and stability of CdS thin film solar cells. Most of the work was concerned with improvements in the formation of the barrier layer and included treatments of the CdS film prior to the formation of the barrier layer, variations in the barrier formation process, and treatments of the film and barrier after formation of the barrier. Author (TAB)

N68-21619# Naval Research Lab., Washington, D. C.
OPTIMAL CROSS SECTION FOR A TOROIDAL INDUCTOR WITH A THIN WINDING
Evan B. Wright Nov. 1967 15 p refs
(NRL-MR-1848; AD-666295)

For a toroidal inductor having a winding of fixed length, the core shape which maximizes the inductive energy is calculated. The solution of this isoperimetric problem is given in terms of Bessel and Struve functions, and some typical cross sections are illustrated. Author (TAB)

N68-21651*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A BREADBOARD FLUERIC-CONTROLLED PNEUMATIC STEPPING MOTOR SYSTEM
William S. Griffin Washington Apr. 1968 67 p refs
(NASA-TN-D-4495) CFSTI: HC $3.00/MF $0.65 CSCL 13G

This report describes flueric circuitry used to drive a novel pneumatic stepping motor. The design and breadboard implementation of the circuitry are presented along with some of the techniques used for interconnection of digital fluid jet amplifiers. The experimental performance of a breadboard flueric-drive-circuitry–stepping-motor actuator system is evaluated. Finally, a comparison is made between the resultant pneumatic stepping-motor system and the more conventional pneumatic piston-in-cylinder actuator. The principal conclusions of the work are: (1) The flueric-drive-circuitry–stepping-motor combination constitutes a reliable, fast, open-loop digital stepping actuator system which has high resolution and output stiffness. The breadboard flueric-drive-circuitry–stepping-motor system could be stepped at 173 steps per second in either direction and cyclicly reversed, without missing steps, at 115 steps per second. The step size of the shaft output motion was 0.25° and a maximum static output torque of 70 inch-pounds force (788.9 cm-N) was obtained. (2) The flueric-drive-circuitry–stepping-motor actuator system consumes more flow than a conventional electropneumatic piston-in-cylinder actuator designed to do the same job. Author

N68-21661# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
EVALUATION OF SINTERED METAL BRAKES FOR THE BAK-12 AIRCRAFT ARRESTING SYSTEM
Alex V. Wolfe and Maurice E. Peters Jan. 1968 75 p
(SEG-TR-67-53; AD-666476)

The report presents the results of a comparison test between a conventional B-52 disk brake and a newly developed sintered metal brake. The conventional B-52 brake, with cermetallic linings, is currently used on the B-52 aircraft and on the BAK-9 and

BAK-12 aircraft arresting systems. The newly developed brake has sintered metal brake linings and is designed for the same applications as the conventional brake. The objective of the test program was to compare the useful life and operating characteristics of the conventional brake with that of the sintered metal brake under conditions of simulated arrestments. The laboratory controlled conditions simulated a BAK-12 arrestment of a 35,000-pound aircraft at a speed of 150 knots. The conventional brake yielded a useful life of 186 arrestments and the sintered metal brake had a life of 427 arrestments. The coefficients of friction for both brakes remained relatively constant throughout the test program. Author (TAB)

N68-21712# Entwicklungs- und Forschungslabor, Lorrach (West Germany).

HYDRO-PNEUMATICAL FIN ACTUATOR [PNEUMATISCH-HYDRAULISCHER RUDERSTELLER]

J. Huegin Bundesministerium fuer Wiss. Forsch. Nov. 1967 23 p In GERMAN; ENGLISH summary

(BMwF-FB-W-67-36) CFSTI: HC$3.00/MF$0.65

From actuators for small rockets, a sufficient torque is required as well as small torque loss during rudder movement, low weight and price, high reliability, and small reaction from the external torque to the rudder position. A pneumatic-hydraulic actuator is described which fulfills these conditions. Its energy source is a high pressure tank made of glass fiber plastics filled with nitrogen (about 200 atmospheres pressure). The gas, expanded to about 10 atmospheres, is operating a statical-effect oil pump, the pressurized oil of which is led to statical-effect actuators via electromagnetical transducers. For the oil pump and the actuators, frictionless roll-membranes and hermetic O-rings which do not need sliding pistons and cylinders, are used. The panels are made of a simple, lightweight, plastic material. The energy-transducing and actuating system has a high mechanical efficiency and needs no pressurized air during stop. Author

N68-21741*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELECTRONIC RESETTABLE FUSE EVALUATION

W. M. Tucker Feb. 1968 26 p Prepared by Electro-Mech. Res., Inc.

(Contract NAS5-10229)

(NASA-TM-X-63160; X-716-68-83) CFSTI: HC $3.00/MF $0.65 CSCL 19A

An electronic fuse has been developed which eliminates most objections to the use of fuses in satellites. When tripped it can be reset remotely by ground command. It can also be opened by ground command and therefore be used also as a switch. The drop in voltage across the fuse is less than 3 millivolts when the current is at the threshold level. Power to operate the fuse comes from a separate source and is only 8.4 milliwatts for a 1/8 ampere fuse. It therefore can be used in a wide variety of voltage systems. It is designed to have an inverse-current time delay characteristic with approximately one second delay at 200% rated current. The threshold level and time delay are somewhat affected by temperature and fuse electronics supply voltage. While it is usable in its present state of development, it is desirable to eliminate or reduce the dependence on temperature and supply voltage and develop further the packaging techniques. Author

N68-21766*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ELECTRICAL PERFORMANCE OF A RHENIUM-NIOBIUM CYLINDRICAL THERMIONIC CONVERTER

Richard M. Williams and William J. Brifano Washington Apr. 1968 23 p refs

(NASA-TN-D-4533) CSCL 10A

The electrical performance of a cylindrical rhenium-niobium thermionic converter was measured by a pulse technique for the following temperatures: emitter, 1873° to 2073°K; collector, 850° to 1050°K; and cesium reservoir, 590° to 670°K. The peak output power densities at 1873°, 1973°, and 2073°K were 7.0, 9.4, and 11.4 W/cm^2 at 0.4, 0.5, and 0.6 V, respectively. The corresponding collector temperatures were about 900°, 940°, and 950°K, and the cesium reservoir temperatures were 595°, 606°, and 611°K. The Rason–Warner correlation was used to estimate a 5.0±0.1 V work function for the vapor-deposited rhenium emitter. Author

N68-21785# Varta Aktiengesellschaft Forschungs- und Entwicklungszentrum, Kelkheim (West Germany).

REACTION MECHANISM, CONSTRUCTION AND ELECTRICAL PERFORMANCE OF A METHANOL-OXYGEN FUEL CELL [WIRKUNGSWEISE, AUFBAU UND LEISTUNGS-DATEN DER METHANOL/SAUERSTOFF-BRENNSTOFF-ZELLE]

H. v. Doehren, D. Spahrbier, and G. Wolf Bundesministerium fuer Wiss. Forsch. Sep. 1967 27 p refs In GERMAN; ENGLISH summary

(BMWF-FB-W-67-26) CFSTI: HC$3.00/MF$0.65

The reaction mechanism of the anodic oxidation of methanol in an acid and alkaline solution respectively is discussed. Consideration is given to the advantages and disadvantages of these systems, taking into account the material problems involved. The evaluation of the two alternatives led to the conclusion that based on present knowledge, the alkaline system is preferable. An electrode system for an alkaline electrolyte is described, and performance data are given for a methanol/oxygen battery employing such electrodes. Author

N68-21805*# Boeing Co., Seattle, Wash. Space Div.

DEVELOPMENT AND FABRICATION OF ADVANCED BATTERY ENERGY STORAGE SYSTEM Final Report, 27 Sep. 1966–26 Oct. 1967

Sidney Gross 27 Nov. 1967 135 p refs

(Contract NAS9-6470)

(NASA-CR-92042) CFSTI: $3.00 CSCL 10C

A silver-cadmium secondary battery energy storage system was developed to meet the power requirements of manned orbital missions of up to one year in duration. Major tasks were to (1) develop and provide eight 28-volt silver-cadmium batteries of more than 70 ampere-hours capacity each; (2) develop and provide four charge-discharge controllers for cycling the batteries, plus instruction manuals; (3) perform a detailed computerized thermal analysis of the battery to accurately predict heat generation and temperatures over a wide range of operating modes; and (4) provide calorimeters for measurement of internal heat generation in two specially instrumented batteries. All requirements were met or exceeded. Work was completed in the areas of cell design, cell venting, battery packaging, calorimeter design, thermal analysis, and controlling the battery charge-discharge test cycle. Author

N68-21819*# Gulton Industries, Inc., Hawthorne, Calif. Engineered Magnetics Div.

APPLIED RESEARCH AND FEASIBILITY STUDIES, EXPERIMENTAL INVESTIGATIONS AND CONCEPTUAL OR PRELIMINARY DESIGN ENGINEERING APPLICABLE TO INVERTERS FOR MOTORS PROGRAM Quarterly Progress Report, 22 Jun.–25 Sep. 1967

D. B. Irvine 5 Oct. 1967 45 p

(Contracts NAS8-20832; NAS8-18013)

(NASA-CR-61718; Rept.-2090; QPR-1) CFSTI: $3.00 CSCL 09A

Research conducted under a program designed to advance the areas of design, efficiency, life expectancy, reliability, and motor performance characteristics of inverters for space vehicle application is reported. Presented are results of applied research and feasibility studies, experimental investigations, and conceptual and preliminary design engineering studies applicable to inverters for motors. Included are data on motor specifications, motor voltage control, and inverter breadboard design, fabrication, and testing. S.C.W.

N68-21821*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISM OF THE PHOTOVOLTAIC EFFECT IN 2–6 COMPOUNDS Progress Report, 1 Oct. 1967–31 Mar. 1968
R. H. Bube, W. Gill, and P. Lindquist 31 Mar. 1968 30 p refs
(Grant NGR-05-020-214)
(NASA-CR-94131; SU-DMS-68R-64; PR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A study designed to formulate and perform a series of experiments to establish the mechanism of the photovoltaic effect in heterojunctions consisting of a II to VI compound and a metallic or quasi-metallic barrier layer is reported. Results of studies focusing on the fabrication and measurement of Cu_2S-CdS heterojunction diodes; observations of I-V characteristics for Cu_2S-CdS diodes; junction capacitance measurements; epitaxial growth of Cu_2S on CdS; and the development of optical microprobe methods; are summarized. Current voltage and capacitance voltage measurements were made on mesa diodes of Cu_2S-CdS. A variety of I-V characteristics were observed for the Cu_2S-CdS diodes at room temperature. Values of the parameter multiplying kT in the exponential forward current expression was between 1.1 and 1.3. An apparent barrier height of 0.6 eV was indicated from the I-V curves. Theoretical expressions for highly asymmetrical heterojunctions were applied to experimental data to give a linear plot of $C^{-1.25}$ vs V, with an indicated barrier height of 0.6 eV. A CdS crystal whose Cd (0001) face was exposed to a Cu^+ solution at 90 C for 24 hours showed a reacted layer about 115 microns thick. Distinct 6-fold symmetry was observed in X-ray back reflection Laue photographs. The properties of the cell formed in this way were measured. The applicability of using a travelling light spot technique to determine minority carrier life-times was demonstrated. S.C.W.

N68-21831*# Stanford Univ., Calif. School of Engineering.
MECHANISM OF THE PHOTOVOLTAIC EFFECT IN 2–6 COMPOUNDS Progress Report, 1 Apr.–30 Sep. 1967
Richard H. Bube, William Gill, and Peter Lindquist 30 Sep. 1967 37 p refs
(Grant NGR-05-020-214)
(NASA-CR-94136; SU-DMS-68-P-10; PR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A study designed to formulate and perform a series of experiments to establish the mechanism of the photovoltaic effect in heterojunctions consisting of a II to VI compound and a metallic or quasi-metallic barrier layer is reported. Focused on is the mechanism of the CdS:Cu cell which is under fabrication commercially and which has potential advantages over the silicon photocells used presently in spacecraft. Data on materials used, and techniques and processes used to produce photovoltaic cells from the single crystal II to VI compounds are given. A total of 41 photovoltaic cells were prepared. Of these, 18 were of conducting CdS, 15 were of intermediate resistivity CdS, 5 were of conducting CdSe, and 3 were of ZnS annealed in excess zinc. CdSe cells in general gave much lower output photovoltage and higher junction capacitance than CdS cells. ZnS cells generally had very low output and very slow response. Cells made with the intermediate resistivity CdS had open circuit photovoltages comparable to those of conducting CdS; however, output current and power was much lower. Measurements of the junction capacitance of CdS cells showed significant differences from the usual voltage dependence of the capacitance of p-n junctions. For all the intermediate resistivity CdS cells tested, the effect of 9000 Å bias light was to decrease the photovoltage at wavelengths shorter than the band edge of CdS sometimes to zero. For the conducting CdS cells, the effects of the 9000 Å bias light was to increase the photovoltage for $\lambda < 7000$ Å, and decrease it slightly for longer wavelengths. The most effective wavelength of bias illumination appeared to be 9000 Å; however no effect has yet been observed for bias light wavelength of 5000 Å. S.C.W.

N68-21835*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE OF FLUERIC ANALOG-TO-PULSE-FREQUENCY-CONVERTER
Miles O. Dustin Washington Apr. 1968 29 p refs
(NASA-TN-D-4497) CFSTI: HC $3.00/MF $0.65 CSCL 13G

A flueric circuit which converts an analog pressure signal to pulse frequency is described, and design considerations are discussed. The performance characteristics of a breadboard model are also included. The breadboard model was constructed to commercial flueric amplifiers and one specially developed amplifier. The circuit uses a three-amplifier, flueric oscillator having a pulsed output whose frequency is a function of input pressure level. The frequency of the oscillator varies continuously from 0 to 180 pulses per second when the input pressure changes from 5.2 psig (36×10^3 N/m^2 gage) to 3.1 psig (21×10^3 N/m^2 gage). The complete converter system will operate from 0 to 180 pulses per second when the input pressure to the converter is variad over a range of 2 psi (13.8×10^3 N/m^2). The converter system has flat saturation characteristics. The oscillator circuit will recover from a step change in input pressure within one output pulse. The flueric amplifiers use supply pressures of 20 psig (138×10^3 N/m^2 gage) or less. The analog-to-pulse-frequency converter will be used to drive a pneumatic stepping actuator system developed for positioning nuclear reactor control drums. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-20582 California Univ., Berkeley.
THE QUANTUM CONVERSION PROCESS OF PHOTOSYNTHESIS. PARAMAGNETIC RESONANCE OF TRANSITION METAL COMPLEXES HAVING BIOLOGICAL INTEREST
Robert Talman Ross (Ph.D. Thesis) 1966 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5152

On the basis of an efficiency argument, it is hypothesized that there should be a linear relationship between the net flow through a biochemical pathway and the free energy lost per unit flow. This hypothesis is compatible with the observed light saturation behavior of photosynthesis. Preliminary extension of this model to include transient behavior correctly predicts the 1/time decay of chemiluminescence observed in plants. The problems and techniques involved in the EPR spectroscopy of transition metals are reviewed, and the literature on the EPR of metal complexes which has biological significance is surveyed. Particular emphasis is placed on the conditions necessary for the observation of paramagnetic resonance, and on the EPR of manganese. Dissert. Abstr.

N68-20610 Rutgers Univ., New Brunswick, N. J.
STUDIES ON MEMBRANE ASSOCIATED PROTEIN SYNTHESIS
Lolita Daneo Moore (Ph.D. Thesis) 1966 193 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-5272

A system derived from cell-free extracts of *Streptococcus faecalis* was used for studies of amino acid incorporation into proteins. This system is capable of sustained and substantial protein synthesis over a period of several hours. Examination of various extract fractions failed to give any evidence of soluble "ribonucleases." In centrifugal fractions of the particulate material, sustained protein synthesis in a completely supplemented system

was a function of the membrane content of the fraction. A membrane associated subunit active in protein synthesis was isolated by sucrose gradient centrifugation. The active subunit contained membrane fraction rich in ninhydrin positive phosphatides, a membrane bound polynucleotide phosphorylase, membrane bound 50s ribosomal subunits, and 30s ribosomal subunits associated with RNA. Disruption of membrane integrity chemically or enzymatically resulted in dissociation of the active subunit, accompanied by a reduction of protein synthesis from a sustained reaction, to one limited to 20–45 minutes. Dissert. Abstr.

N68-20900# School of Aerospace Medicine, Brooks AFB, Tex.
OBSERVATIONS ON THE EFFECTS OF DECABORANE AND SEVERAL POTENTIAL ANTIDOTES IN THE RAT
Lloyd L. Foster and Walter N. Scott Oct. 1967 19 p refs
(SAM-TR-67-103; AD-665838)

Rats were injected intraperitoneally with decaborane (B10H14) and observed over a seven-day period to determine their toxic reactions, including death rate. Pyridoxine, pyridoxal, and pargyline (MO-911) were tested in the decaborane-treated rats as antidotes for the observed manifestations of the boron hydride injection. In these studies pyridoxine (1 mmole/kg.) given simultaneously with decaborane prevented the convulsions and hyperactivity usually seen in rats treated with decaborane alone (20 mg./kg.) and caused a significant decrease in the number of deaths. Pargyline, 50 mg./kg., given with the decaborane gave no significant alteration of the CNS symptoms, but significantly reduced the mortality rate. Pyridoxal phosphate and a higher level of pyridoxine (2 mmoles/kg.) were without beneficial effect. Some implications of the data are discussed. Author (TAB)

N68-20919# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
SURVIVAL OF RATS EXPOSED TO 10 PSIA OXYGEN TO FURTHER EXPOSURE AT ONE ATMOSPHERE OXYGEN
George H. Kydd 29 Dec. 1967 51 p refs
(NADC-MR-6714; AD-665675)

A rather sharp difference in the effects of exposure to 100% oxygen occurs at around 600 mm Hg PO2 in that pressures slightly higher cause death in most small laboratory animals whereas most animals survive slightly lower pressures. The present experiments were designed to indicate whether there is a relationship between exposures at the lower and higher pressures. The results show that a large percentage of rats pre-exposed at 516 mm Hg (2/3 atmosphere) survive subsequent exposure at PO2 of one atmosphere (714 mm Hg) indicating that a non-additive relationship exists. Author (TAB)

N68-20957# Systems Research Labs., Inc., San Antonio, Tex.
RESEARCH ON THE HUMAN PHYSIOLOGIC RESPONSE TO PROLONGED ROTATION AND ANGULAR ACCELERATION. A: ENGINEERING ACTIVITIES B: PHYSIOLOGIC ACTIVITIES
W. E. Rothe, Edward E. Pope, Samuel T. Lim, and John G. Fletcher Brooks AFB, Tex. School of Aerospace Med. Sep. 1967 155 p refs
(Contract AF 41(609)-2897)
(SAM-TR-67-89; AD-665849)

Physiologic research has explored the responses of humans to rotation and acceleration. The test vehicle was the Rotational Flight Simulator, an air bearing suspended sphere with unrestricted rotational freedom propelled by internally mounted inertia rings and, later, by a single axis external drive assembly. Engineering efforts established the dynamics and improved the control of the vehicle. Instrumentation was provided for the readout, display, and recording of significant data serving for physiologic evaluation and medical monitoring. The data were telemetered; pictorial display of the subject and two-way communication links were provided. A total of 138 experiments yielded valid physiologic and human performance information in a rotational environment from fractional to 16 rpm and for several minutes to a maximum of 30 minutes. The subjects consisted of 7 young, healthy males. Results indicated that the RFS properly used and instrumented represents a valuable and unique test vehicle; that changes in heart rate, and ECG readings depended on body position with respect to gravity; that electro-oculogram, subjective sensations, incipient nausea, and ability of the pilot to right the stationary sphere after tumbling--all depended on the rate, duration, and axis pattern of rotation. Author (TAB)

N68-21016# School of Aerospace Medicine, Brooks AFB, Tex.
HASTENING RESPIRATORY ACCLIMATIZATION TO ALTITUDE WITH BENZOLAMIDE, OCTOBER 1966–MAY 1967
Richard S. Kronenberg and Stephen M. Cain Oct. 1967 15 p refs
(SAM-TR-67-98; AD-665839)

A double-blind study involving 72 hours exposure to a pressure altitude of 14,000 feet (447 torr) was carried out on 23 subjects to ascertain whether benzolamide (CL 11,366) hastened respiratory acclimatization to altitude better than did acetazolamide, another carbonic anhydrase inhibitor previously investigated. Samples of arterial blood, plasma, and cerebrospinal fluid (CSF) were taken at 24 and 72 hours at altitude and analyzed for pH, PCO2, PO2, CO2 content, HCO3-, standard HCO3-, lactate, Na(+), K(+), and Cl(-). End-tidal PCO2, was measured frequently during waking hours, and CO2 response curves were measured daily. Three 24-hour urine collections were analyzed for Na(+), K(-), Cl(-), and 17-hydroxy-corticosteroids. Subjects filled out questionnaires to evaluate their subjective responses to altitude and were ranked by an observer according to their apparent state of well-being. Changes in physiologic variables were consistent with more rapid respiratory acclimatization, and the subjective data indicated that the drug was helpful in ameliorating acute altitude sickness. Benzolamide was not clearly better in either respect than acetazolamide. Author (TAB)

N68-21024# Naval Applied Science Lab., Brooklyn, N. Y.
GLOSSARY OF RADIOMETRIC AND PHOTOMETRIC CONCEPTS USED IN RETINAL BURN AND FLASHBLINDNESS RESEARCH (DEFINITIONS, SYMBOLS AND UNITS) Progress Report
Willard Derksen and Neil Griff 23 Dec. 1967 19 p refs
(PR-18; AD-665790)

Radiometric and photometric concepts, symbols, units and definitions which are employed by the Naval Applied Science Laboratory in its retinal burn and flashblindness research are given. Author (TAB)

N68-21043 Missouri Univ., Rolla.
AERATION STUDIES IN SUBMERGED FERMENTATIONS USING A STEAM-STERILIZABLE DISSOLVED OXYGEN SENSOR OF IMPROVED DESIGN
Carl Justin Wallace (Ph.D. Thesis) 1967 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-60

A steam-sterilizable oxygen sensor of improved design was developed out of an investigation of several potential sensors. Use was made of the steam-sterilizable oxygen sensor for the determination of the effect of impeller speed and aeration rate on the absorption coefficient of a small, 5 liter pilot-plant fermentor. Amylase production by *Aspergillus niger*, glutamic acid production by *Brevibacterium divaricatum*, and gluconic acid production by *Pseudomonas fluorescens* were studied at various aeration efficiencies. It was found that for all fermentations, an increase in the aeration efficiency resulted in an increase in the rate of product formation as well as an increase in total yield. Since the effect of

dissolved oxygen on product formation by microorganisms was investigated, it was also of interest to determine the critical oxygen tension of these and other organisms. The critical oxygen tension of *Myrothecium verrucaria* and *Torulopsis utilis* was determined as was that of the three organisms previously mentioned. The critical oxygen tension for the bacteria, *B. divaricatum* and *P. fluorescens*, and yeast, *T. utilis*, was extremely low, while that of the fungus, *A. niger*, was high. *M. verrucaria*, although a fungus, exhibited a critical oxygen tension close to that of the bacteria and yeast. Dissert. Abstr.

N68-21059 Iowa State Univ. of Science and Technology, Ames.
THE EFFECTS OF LIGHTNING AND SIMULATED LIGHTNING ON TISSUES OF ANIMALS
James Raley Howard, III (Ph.D. Thesis) 1966 277 p
Available from Univ. Microfilms: HC $12.60/MF $3.60 Order No. 67-5596

Lightning-strike pathology in livestock with an evaluation of patho-physiologic responses to simulated lightning discharges in sheep and tissue culture cells. In 63 detailed necropsies of lightning fatalities, singed hair and skin were the only significant lesions caused by lightning. Characteristically the lymph nodes of the head and neck were congested and hemorrhagic, as were the lungs and brain. Microscopically these tissues were congested and hemorrhagic-appearing changes developed after death. Dissert. Abstr.

N68-21067*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.
PLANETARY QUARANTINE PROGRAM Quarterly Progress Report, Period Ending 31 Mar. 1968
Mar. 1968 22 p refs
(NASA Order R-09-019-040; NASA Order H-13245A)
(NASA-CR-93966; QR-8) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Progress is reported for seven studies related to planetary quarantine procedures. An objective hierarchy is being constructed to determine what actions are needed to achieve planetary quarantine objectives on a cost optimal basis. Microbial death models are under consideration, and tests of model flexibility were carried out for data on the thermal sterilization of yeast. Information system design was considered for meeting both lunar and planetary quarantine responsibilities, and estimating and predicting microbial burdens of spacecraft surfaces is discussed. Attention is given to vacuum probe development in relation to removal of surface contamination for evaluation of microbial content, and random fine surface particles were studied. Preparation of a contamination control handbook is underway. M.W.R.

N68-21078*# Public Health Service, Phoenix, Ariz. Planetary Quarantine Unit.
SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS
M. S. Favero Apr. 1968 25 p
(NASA Order R-137)
(NASA-CR-93967; Rept.-21) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Various ecological investigations are underway, and a statistical analysis was completed of the probability of release of Bacillus subtilis var. niger spores from fracture lucite. Microbiological sampling of surfaces with a vacuum probe is described that uses a membrane filter capable of withstanding insonation and a shortened probe tip and conical section. Efforts were made to standardize the inoculation, storage, and transportation of stainless steel strips for use as split samples and as biological indicators of the effectiveness of ultrasonic baths. Studies were continued on the kinetics of dry heat inactivation of naturally occurring spore populations, as were studies concerning the use of ultrasonics for recovering microorganisms from surfaces. Microbial contamination detected on various surfaces of Surveyor 7 are being studied, as are contamination on Apollo spacecraft. M.W.R.

N68-21138# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE DICYANAMIDE MEDIATED SYNTHESIS OF DIPEPTIDES
Steven Gary Platt (M.S. Thesis) Dec. 1967 29 p refs
(Contract W-7405-ENG-48)
(UCRL-17936) CFSTI: HC $3.00/MF $0.65

An attempt to repeat the earlier research that showed DCA dicyanamide to be an effective mediator of glycine condensation was not successful, that is, the earlier glycine work was not reproduced. Several possible explanations are given for the discrepancy. A procedure was developed, after extensive theoretical and experimental investigation, that will allow for the answering of the research question on relative yields of 4 dipeptides in a DCA-mediated condensation reaction. That procedure is based upon the use of high-voltage paper electrophoresis and paper chromatography. It allows for the separation, and quantitative yield measurement, of the dipeptide reaction products of DCA mediated condensation occurring in a model system initially containing equal concentrations of two amino acids. The procedure was tested with the phenylalanine–glycine system, and found to successfully separate the four possible dipeptide products. Semiquantitative information concerning the yields of dipeptide were obtained for the DCA mediated condensation of the amino acids valine, leucine, and phenylalanine. NSA

N68-21139*# Stanford Univ., Calif. Dept. of Biochemistry.
STRUCTURE AND FUNCTION OF PROTEINS AND NUCLEIC ACID Progress Report, 1 Jul.–31 Dec. 1967
Lubert Stryer 31 Dec. 1967 4 p refs
(Grant NGR-05-020-137)
(NASA-CR-93963) CFSTI: HC $3.00/MF $0.65 CSCL 06A

In continuing research the conformation of pyridine nucleotide coenzymes β-DPN, β-DPNH, their isomers, analogues, and related model compounds were studied by optical rotary dispersion and circular dichroism measurements. The binding of azide ion to two mutant human ferrihemoglobins is reported, and the subunit interaction in tryptophan synthetase is briefly mentioned. Consideration is also given to triplet–singlet energy transfer which was exhibited by a complex of α-chymotrypsin and proflavin, a chromophoric inhibitor. B.S.D.

N68-21158# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
BAND ULTRACENTRIFUGATION TECHNIQUE FOR THE ANALYSIS OF MACROMOLECULES [IL METODO DELLA SEDIMENTAZIONE A ZONE PER L'ANALISI DI MACROMOLECOLE IN ULTRACENTRIFUGA ANALITICA]
L. Danusso and A. Reale Scafati 5 Oct. 1967 42 p refs in ITALIAN; ENGLISH summary
(ISS-67/33) CFSTI: HC $3.00/MF $0.65

The technique of band sedimentation in the analytical ultracentrifuge has been introduced recently for the study of macromolecular species. In the present report the principal features of this method are described, and the advantages in comparison with other techniques are discussed. The method has shown particularly well suited for the study of heterogenous mixtures, mainly because it is possible to obtain sedimentation coefficients and relative concentrations independent from the total concentration and from the Johnston–Ogston effect. An application to the analysis of ribosomal extracts is reported, and some results are shown. Author

N68-21193# School of Aerospace Medicine, Brooks AFB., Tex.
PECULIARITIES OF AUDITORY ANALYSER FUNCTION DURING PROLONGED EXPOSURE TO A CHANGED GAS ENVIRONMENT [OSOBENNOSTI FUNKTSII SLUKHOVOGO ANALIZATORA PRI ULITEL'NOM PREBYVANII CHELOVEKA V USLOVIYAKH IZMENENNOY GAZOVOY SREDY]

Ye. M. Yuganov, Yu. V. Krylov, and V. S. Kuznetsov 1967 7 p Transl. into ENGLISH from Russian Presented at the 18th Congr. of Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(SAM-TT-R-943-0268; AD-665792)

Studies were made of mans response to reduced barometric pressure (308 mm Hg) with normal pO2, to 2% CO2 air, and to a helium and oxygen atmosphere. Dynamic audiometry and studies of the time required for reverse auditory adaptation revealed no tendencies for deviation beyond the physiologic norm. Notably, the auditory analysor displays great tolerance to space cabin atmospheres. Author (TAB)

N68-21237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY. 21: BIOMEDICAL ENGINEERING
Kirby W. Hiller Washington 1968 24 p ref Presented at Lewis Aerospace Explorers Conf., Cleveland, 1966–1967
(NASA-TM-X-52408) CFSTI: HC$3.00/MF$0.65 CSCL 06E

The four main areas in which biomedical engineering principles are applied to biology and medicine are discussed. They include diagnostics, treatment, prosthetics, and biological research. Infrared and X-ray photography, machines for blood diagnosis, automatic monitoring equipment for intensive care patients, and computerized diagnosis, are some of the major developments considered in the area of diagnosis. The heart lung machine, heart assist pump, lasers, cryogenic probe, and air-inflated Hoverbed for burned patients, are examples of medical engineering equipment which makes new treatment techniques possible. Details are given on the functions and operations of an automatic heart, and brief consideration is given to other areas of prosthetics such as artificial kidneys and limbs. An assessment is made of some major developments in biological research and the incompatibility of man and his machines. B.S.D.

N68-21339# HRB-Singer, Inc., State College, Pa.
PSYCHOLOGICAL FACTORS RELATED TO TOLERANCE OF CONFINEMENT Final Report
C. E. Newmiller, P. S. Francis, and R. B. Cooper Nov. 1967 129 p refs
(Contract OCD-PS-65-5)
(Rept.-75111-3F; AD-666233)

The report presents the findings of two shelter confinements. Two fifty-one-person groups were separately confined in a fallout shelter for sixty-seven hours each. Several psychological measures were employed in the study, and their applicability to it is discussed. The effect of a trained shelter manager on defections and other in-shelter behavior is also presented. Author (TAB)

N68-21368# Human Engineering Labs., Aberdeen Proving Ground, Md.
CRITERIA FOR ASSESSING HEARING DAMAGE RISK FROM IMPULSE-NOISE EXPOSURE
R. Ross A. Coles, Georges R. Garinther, David C. Hodge, and Christopher G. Rice Aug. 1967 128 p refs
(TM-13-67; AD-666206)

Criteria are presented for assessing damage risk from impulse-noise exposure. The criteria are based on conclusions of independent British and American studies and on the work of other research workers in this field. Most of the studies which led to these criteria were performed with noise from small arms, but the criteria are general enough to permit assessment of most other types of impulse noise. The variables which must be considered in determining the potential hearing hazard and in making practical application of the criteria are presented, and the parameters which must be measured are defined. The measurement technique and type of transducers to be used are discussed. Author (TAB)

N68-21383*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
REVIEW OF NASA-MSC ELECTROENCEPHALOGRAM AND ELECTROCARDIOGRAM ELECTRODE SYSTEMS INCLUDING APPLICATION TECHNIQUES
J. L. Day Washington Apr. 1968 16 p refs
(NASA-TN-D-4398) CFSTI: HC$3.00/MF$0.65 CSCL 06B

The development and evaluation of a silver/silver chloride/gelatinate matrix electrode with a specially prepared electolytic paste are described. The system was developed to enhance readings of space flight electroencephalogram, electrocardiogram, and respiration monitoring systems. Details of the electrode, electrolytic paste, harness assembly, and integument subsystems are given followed by a step by step presentation of application procedures. These electrodes are more artifact free than conventional electrodes. If the application procedure is followed meticulously, the electrodes will remain in place and provide a high quality signal for long periods. Dermatological and microbiological tests show that the paste and electrodes are nonirritating and cause insignificant microbial proliferation during 14-day periods. R.N.A.

N68-21387# Argonne National Lab., Ill.
INVESTIGATIONS ON THE PERCEPTION OF THE GRAVITY STIMULUS [UNTERSUCHUNGEN UEBER DIE PERZEPTION DES SCHWERKRAFTREIZES]
C. J. Rutten-Pekelharing Oct. 1967 79 p refs Transl. into ENGLISH from Rec. Trav. Botan. Neerl. (Germany), v. 7, 1910 p 241–344
(ANL-TRANS-545) CFSTI: HC$3.00/MF$0.65

The perception of stimuli by plants resulting in phototropic and geotropic responses is directly affected by the duration and intensity of these stimuli. This hypothesis was experimentally investigated using Avena coleoptiles subjected to gravitational and centrifugal forces and light stimuli of varying intensities and durations. The results indicate that the perception of these stimuli is predicated on the position of the coleoptile at a given intensity for a given duration of the stimuli. The results of the investigation may be summarized as follows: the produce of the effective force and the presentation time is constant for gravity and centrifugal stimulations for the same plant under the same conditions; the perception of the gravity stimulus is not equal to that of the light stimulus; and roots from which the starch was removed can still react geotropically even though damage is evident. A bibliography of the early investigations in this area is included. NSA

N68-21392# Army Medical Research Lab., Fort Knox, Ky. Biophysics Div.
SOME EFFECTS ON RUBY LASER IRRADIATION ON RAT PERFORMANCE Interim Report
Samuel H. Revusky 16 Nov. 1967 29 p refs
(Rept.-759; AD-666179)

A total dose of 100 joules delivered during 1.8 ms at a density of 20 j/sq cm on the midline of the abdomen disrupted performance in the presence of the rewarded stimulus, but did not appear to disorganize the animals; that is, the discrimination between the rewarded stimulus and the nonrewarded stimuli remained intact. The effect disappeared on the third day after irradiation. Lower doses appeared to be ineffective, although differences in individual susceptibility to irradiation preclude a definite finding at this point. A similar dose of 200 joules to the head appeared to be the threshold for performance decrement. There was some evidence that head injury could produce a longer lasting performance decrement and could disorganize behavior in a manner not obtainable with irradiation of the abdomen. Author (TAB)

N68-21397# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
ADAPTATION TO PROLONGED CONSTANT ANGULAR ACCELERATION Progress Report

James H. Brown and James W. Wolfe 31 Jan. 1968 40 p refs
(AMRL-764; AD-666178)

Two independent groups of normal human subjects were exposed to a number of long-duration (up to 96 sec), relatively high-intensity (3 degrees/sec sq - 24 degrees/sec sq) constant, angular accelerations. Nystagmic decrements during stimulation were clearly evident. The decrements were initiated at about the same time after stimulus onset (30-35 sec) for all accelerations used. The decrements in the nystagmic responses were compared to related findings for both subjective and electrophysiological responses. Author (TAB)

N68-21405 National Institutes of Health, Bethesda, Md. Library Translating Unit.
CHANGES IN CIRCULATORY AND NEUROPSYCHOLOGICAL CONDITIONS BROUGHT ABOUT BY SOME PSYCHOLOGICALLY ACTIVE DRUGS UNDER ENVIRONMENTAL HYPERBARIA
G. Albano, A. Di Benedetto, P. M. Criscuoli, T. Indovina, A. Candia et al 15 Feb. 1968 8 p refs Transl. into ENGLISH from Boll. Soc. Ital. Biol. Sper., no. 39, 1963 p 2082-2085

Interrelations among various changes in the circulatory and neurophysiological conditions of humans resulting from the administration of psychologically-active drugs administered under environmental hyperbaria were investigated. When six expert skin divers were subjected to a mixture of 8.64 atm nitrogen and 0.36 oxygen, partial improvement of mental functions were obtained with ritalin and centrophenoxine and appeared to be independent of any hemodynamic changes; there was almost no increase in cerebral flow with the latter, although dextroamphetamine which gives rise to distinct improvement of cardiocirculatory conditions does not diminish errors in an arithmetic test. Increased drug dosage does not bring about increased mental functioning. M.W.R.

N68-21419# School of Aerospace Medicine, Brooks AFB, Tex.
WATER RECOVERY FROM HUMAN LIQUID WASTES BY DISTILLATION AND CHEMICAL OXIDATION
Michael J. Ryan and Edward Edgerley, Jr. Dec. 1967 31 p refs
(SAM-TR-67-110; AD-666471)

The recovery of potable water from human urine by atmospheric and vacuum distillation and by chemical oxidation was investigated, utilizing the parameters of organic carbon, biochemical oxygen demand, and chemical oxygen demand. Linear relationships existed between organic carbon, BOD, and COD for the human urine samples studied. The ratio of organic carbon to BOD equaled 1.34; that of BOD to COD equaled 0.52; and that of organic carbon to COD equaled 0.64. The vacuum distillation of urine yielded a water suitable for human consumption. The chemical oxidation of human urine by ozonation was not found to be a practical means of treatment and water recovery because of the excessive quantities of ozone required. Author (TAB)

N68-21434# Indiana Univ., Bloomington. Cardiopulmonary Lab.
ATTEMPTED ACCLIMATIZATION BY VIGOROUS EXERCISE DURING PERIODIC EXPOSURES TO SIMULATED ALTITUDE Technical Report, Sep. 1965-Apr. 1966
Raymond H. Murray, Spencer Shropshire (AMRL), and Leonard Thompson Wright-Patterson AFB, Ohio AMRL Sep. 1967 18 p refs
(Contract AF 33(616)-8378)
(AMRL-TR-67-114; AD-666044)

Acclimatization to altitude by means of periodic short-term chamber exposures could have military and athletic application by preparing unacclimatized subjects for endurance performance at altitude. Three unconditioned men were trained daily by endurance running for 3 weeks at ground level. Following control measurements, they exercised strenuously on a treadmill 2 hours daily for 17 days in a chamber at a simulated altitude of 2300 meters. Responses were evaluated by: symptoms; maximum work performance (as measured by the duration of exercise-to-tolerance); maximal heart rate; duration of breath-holding; production of lactate and excess lactate; maximum expiratory minute volume and oxygen consumption. During the initial periods of exercise at altitude, maximum work performance fell significantly from control levels (average 23%), with striking symptoms of exhaustion; breath-holding duration fell 13%; the production of excess lactate rose significantly in two subjects. Over the remainder of the altitude exposures exercise performance and breath-holding duration increased to near control levels while fatigue was much less noticeable. Maximal heart rate varied greatly. There was no significant change in maximal oxygen consumption during exercise at altitude, but expiratory minute volume rose slightly. During the period of altitude exposures, symptoms common with chronic exposures (malaise, Cheyne-Stokes respiration, rheumatic complaints) were often noted both in the chamber and at work and at home. Author (TAB)

N68-21469# Michigan State Univ., East Lansing. Div. of Engineering Research.
ON RELATING THE BEHAVIOR OF A SYSTEM TO THE BEHAVIOR OF ITS CONSTITUENTS. CELLULAR DIFFERENTIATION AND THE APPLICATION OF LIAPUNOV'S DIRECT METHOD TO STATISTICAL MECHANICS Interim Scientific Report
Philip S. Ulinski and William L. Kilmer 31 Jan. 1968 68 p refs
(Contract AF 19(628)-5076; Grants AF-AFOSR-1023-66; AF AFOSR-1023-67)
(AFOSR-68-0217; ISR-1; AD-666469)

The problem of relating microscopic processes to macroscopic processes is discussed by studying the way in which the morphological states of animal and plant cells are related to their metabolic pathways and by introducing an entropy concept based on the stability of the molecular equations of motion. The use of Liapunovs direct method instead of probability methods in many-body problems is stressed. Author (TAB)

N68-21628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIATION INJURY OF MYELOPOIESIS IN MONKEYS [LUCHEVOYE PORAZHENIYE KOSTNOMOZGOVOGO KROVOTVORENIYA U OBEZ'YAN]
M. I. Novikova 8 Sep. 1967 11 p refs Transl. into ENGLISH from Med. Radiol. (USSR), v. 10, no. 6, 1965 p 42-46
(FTD-MT-24-154-67; AD-666139)

540-630 R of gamma radiation completely suppressed hemopoiesis in monkeys. During the first 8 days after exposure, leukocyte count in the peripheral blood dropped sharply, but the red blood cells showed no significant abnormalities. From the 9th to the 19th day, suppression of hemopoiesis became more pronounced. The leukocyte count dropped further and the concentration of hemoglobin decreased in the red blood cells. 30% of the animals died during this period but the first signs of recovery began to appear—occasional immature cell forms in the red marrow, and reticulocytes in the peripheral blood. During the third or restorative period (20th to 60th day) the animals appeared completely healthy, and the peripheral blood indices were more or less normal. It is suggested that these experiments may help to uncover the mechanisms underlying the development of leukemia and aplastic anemia caused by ionizing radiation. Author (TAB)

N68-21659*# Exotech, Inc., Washington, D. C.
STUDY OF ANALYTICAL TECHNIQUES IN PLANETARY QUARANTINE Final Report
7 Dec. 1967 106 p refs
(Contract NASw-1550)
(NASA-CR-94135) CFSTI: HC $3.00/MF $0.65 CSCL 06T

This report summarizes analyses related to two major areas of the NASA Planetary Quarantine Program, viz, 1. Methods for the formulation of planetary quarantine standards and for the definition of measures of compliance. Emphasis in this area is placed upon the simplification and clarification of several concepts within the quarantine requirements framework, as well as a sensitivity study of program implementation. 2. Analytical techniques related to the heat sterilization of planetary spacecraft. Emphasis in this area is placed upon survival model development, evaluation of experimental data, model parameter estimation, the sterilizing effects of heat-up and cool-down and the feasibility of a physical diffusion model of microbial resistance to heat sterilization. Author

N68-21730# California Univ., Davis. Radiobiology Lab.
FISCAL YEAR 1967 Annual Report
Jun. 1967 88 p
(Contract AT(04-3)-472)
(UCD-472-114) CFSTI: HC $3.00/MF $0.65

Clinical observations on the effects of single and fractionated whole body X-irradiation and radionuclide toxicity in female beagles are reported. Preliminary reports are included on the survival of control and irradiated beagles, the age and causes of death in control and irradiated subjects, and the ultrastructure of normal and neoplastic mammary tissues of the beagle. Hepatic lesions in control and irradiated beagles are described, and a discussion is presented on the use of beagles as experimental dogs. The bone seeking radionuclides strontium 90 and radium 226 are examined in the toxicity studies. E.J.S.

N68-21798# School of Aerospace Medicine, Brooks AFB, Tex.
AEROSPACE PSYCHIATRY—RESEARCH CONSIDERATIONS
Terence F. Mc Guire *In its* 14th Ann. Conf. of Air Force Behavioral Scientist Dec. 1967 p 225–240 refs (See N68-21795 11-05)

Psychiatric selection methods for hazardous duties and problems of stress psychophysiology are discussed in terms of aerospace research activities, and it is speculated that total knowledge today may not be adequate for future needs. Mention is made of Air Force pilot population, from which the selectees for civilian and military space endeavors have usually been chosen; and consideration is given to aerospace crew size, crew environment, and mission duration. Use of psychoanalytic procedures is discussed, as are group therapy methods; and patterned and other response patterns are mentioned. M.W.R.

N68-21799# School of Aerospace Medicine, Brook AFB, Tex.
PERFORMANCE OF RHESUS MONKEYS DURING CONTINUOUS LOW-LEVEL GAMMA RADIATION
Robert G. Braun, Donald N. Farrer, William Zappini, and Guy H. Crook, II *In its* 14th Ann. Conf. of Air Force Behavioral Scientist Dec. 1967 p 304–313 refs (See N68-21795 11-05)

Nonlethal effects of sustained low-level radiation on primate behavior is considered in terms of the performance of six mature rhesus monkeys weighing between 4.8 and 5.3 kg. The four tasks studied were (1) a Sidman avoidance schedule on a right-hand lever using a 5 sec stimulus-response (S-R) interval, (2) discrete avoidance to 1000 cps auditory cue with 3 sec S-R interval, (3) discrete avoidance to visual cue with 3 sec S-R interval, and (4) 50:1 fixed ratio for a food reward on a left-hand lever. Temporal relationship of these tasks is shown, and mean blood sampling results are given for various times before and after exposures. The food-rewarded task appeared to be a sensitive measure of early radiation sickness from which recovery is relatively assured. M.W.R.

N68-21826# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
30 DAY PRIMATE EXPERIMENT BIOSATELLITE SYSTEM DEVELOPMENT, PHASE 1 Final Report, 1 Dec. 1966–15 May 1967
J. R. Harris Sep. 1967 212 p refs
(Doc.-67SD7075)

Reported are results of electrical system development tests on the 30 day biosatellite Vehicle 103 which were performed to establish electrical interface compatibility between the adapter, reentry vehicle, and the associated aerospace ground equipment (AGE). Test objectives were: (1) to verify subsystem/system electrical interface compatability; (2) to verify and evaluate the electrical performance characteristics of the system during specified controlled changes of primary power voltages within system limits; (3) to verify that system performance is within specification; and (4) evaluate the capability of the electrical AGE to control and monitor electrical system performance. Tests performed established the electrical performance of the vehicle and its basic design. The vehicle was satisfactorily exercised at three different primary power input voltages (AGE supply) to conform with the specified lower, nominal, and upper values. Most of the subsystems/systems operated electrically within their design specification. The work performed enabled an extensive evaluation of the vehicle electrical systems and the data and information derived was used in planning future test phases and also to correct design discrepancies prior to prime vehicle manufacture. S.C.W.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-20600# Junta de Energia Nuclear, Madrid (Spain). Seccion de Isotopos.
FOOD PRESERVING BY IRRADIATION. PART 5. ECONOMIC STUDY OF THE POTATO MARKET IN SPAIN AND THE FEASIBILITY OF PRESERVATION BY IRRADIATION [CONSERVACION DE ALIMENTOS POR IRRADIACION, 5: ESTUDIO ECONOMICO DEL MERCADO DE PATATAS EN ESPANA Y POSIBILIDADES DE SU CONSERVACION POR IRRADIACION]
A. Rivas, A. Garcia de Mateos, N. Ortin Sune, and M. del val Cob Apr. 1967 41 p refs In SPANISH; ENGLISH summary
(JEN-184-SI/I-17, Pt. 5) CFSTI: HC $3.00/MF $0.65

A study of the Spanish potato market is carried out in order to know the possibilities of preservation by irradiation. The study is initiated with a compilation of statistical data on the production and consumption of potatoes by regions and seasons. Last years losses are then estimated. In order to evaluate the monthly consumption, two ideal standard markets have been established, being the price differences between the highest and lowest demand months of five arbitrary units. From these, a medium standard market is proposed. This situation would be reached when better preservation means were practized. In this medium market the price differences would be three. It is concluded that about 0.1×10^6 ton of potatoes could be irradiated in Spain along a period of 5.5 months. Author (ESRO)

N68-20663 Texas Univ., Austin.
THIN FILM SENSORS OF MICRON SIZE AND APPLICATIONS IN BIOTHERMOLOGY
Ray Paul Reed (Ph.D. Thesis) 1966 211 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-3343

New methods of controlling the geometry of functional thin film deposits by vapor deposition onto filamentary substrates are described. A variety of junction and multiterminal configurations useful for miniature electrophysical devices can be produced by this means. Examples are multiple sensors on a single slender probe and

sensors with active regions confined to micron-order dimension. The concept was demonstrated by producing temperature sensors as small as 1 micron diameter. An analysis of transient temperature response for embedded sensors of this class was made in the context of application to the measurement of temperatures in living systems. Dissert. Abstr.

N68-20690# School of Aerospace Medicine, Brooks AFB, Tex. Biosciences Branch.
A DYNAMIC FLOW GASSING CHAMBER FOR TOXICOLOGY STUDIES WITH SPECIAL REFERENCE TO ITS USE WITH NO_2. SEPTEMBER 1964–APRIL 1967
William E. Britz, Jr., John L. Steele, Charles E. Dasher, and August R. Banknieder Sep. 1967 19 p refs Submitted for publication
(SAM-TR-67-80; AD-665844)

To test the toxicity of nitrogen dioxide/nitrogen tetroxide and other gases, it was necessary to construct an exposure chamber for small laboratory animals. This report describes the construction and operation of a small dynamic flow gassing chamber for studying toxic gas inhalation. Special attention is given to its use with NO2/N2O4 and the system for monitoring the concentration of gas. Several accessories for the chamber include a special harness for monitoring chest sounds of the subjects being gassed; a system for endotracheal intubation for allowing the subject to breathe the gas concentration, while being manipulated surgically outside the chamber; and, a small by-pass chamber for small laboratory animal species being utilized in timed-dose studies. Author (TAB)

N68-20743# School of Aerospace Medicine, Brooks AFB, Tex. Biodynamics Branch.
MOL: CREW PERFORMANCE ON DEMANDING WORK/REST SCHEDULES COMPOUNDED BY SLEEP DEPRIVATION
Bryce O. Hartman and George K. Cantrell Nov. 1967 34 p refs
(SAM-TR-67-99; AD-665845)

Thirteen subjects took part in a series of 12-day runs in an experiment on the effects of demanding work/rest schedules (4/2, 4/4, or 16/8 hours). On days 8, 9, and 10, subjects were deprived of sleep and worked continuously. No significant work/rest effects were seen until subjects were sleep-deprived. In general, subjects on the 16/8 schedule tolerated sleep deprivation better and recovered faster, as evidenced by psychomotor test scores and sleep reports. Author (TAB)

N68-20753# Dunlap and Associates, Inc., Santa Monica, Calif.
TECHNIQUE FOR ESTABLISHING PERSONNEL PERFORMANCE STANDARDS (TEPPS) PROCEDURAL GUIDE
Meredith B. Mitchell, Russell L. Smith, Ronald A. Westland, and Robert E. Blachard Jan. 1968 144 p refs Second Edition
(Contract Nonr-4314(00))
(AD-665689)

The report is a procedural guide for the application of a Technique for Establishing Personnel Performance Standards (TEPPS). It specified the types of input data required, provides instructions and examples on how to proceed through the various steps in TEPPSs application and includes guidelines for interpretation of results. The TEPPS computer program procedures also are discussed along with instructions for use. Author (TAB)

N68-20795# Vermont Univ., Burlington. Div. of Anesthesia.
A COMPUTERIZED METHOD FOR INSTANTANEOUS AND CONTINUOUS MEASUREMENTS OF EXPIRED NITROGEN Final Report, 1964–1966
John Abajian, Jr., Tamotsu Shinozaki, John S. Hanson, and Burton S. Tabakin Wright-Patterson AFB, Ohio AMRL Sep. 1967 68 p refs Prepared in cooperation with State Agriculture Coll.
(Contract AF 33(615)-2262)
(AMRL-TR-67-77; AD-665873)

The basis for the on-line study of pulmonary nitrogen washout by hybrid computer is presented. The instrument produces a semilogarithmic plot of nitrogen concentration in expired gas versus cumulative alveolar ventilatory volume. Simultaneous measurements of functional residual capacity and main conducting airway volume are also recorded. Comparison of conventional washout methods and computer technique proved the validity of the computer. Secondly, a new index of intrapulmonary gas distribution is devised. The index (IDI or Inspired Gas Distribution Index) is quite sensitive to any change of the gas distribution in the lung and has a very small physiological variation (1.8 plus or minus 0.2). As one application of this computer in research, the effect of expiratory obstruction in normal subjects is studied. A 5 mm. diameter obstruction does not affect the gas distribution in the supine position, whereas the obstruction has a striking effect on gas distribution when a subject is exercising in the upright position. Author (TAB)

N68-20923# School of Aerospace Medicine, Brooks AFB, Tex.
STUDIES ON FROZEN FOIL PACK MEAL COMPONENTS, 15 JUNE 1966–25 MAY 1967
Robert K. Nelson, Jack R. Audiss, Raymond A. Madson, Joseph T. Cordaro, Norman D. Heidelbaugh et al. Sep. 1967 23 p refs
(SAM-TR-67-84; AD-665847)

Components selected from the foil pack meal feeding system were prepared (cooked and packaged) in a foil pack kitchen, frozen, stored in the frozen state, and evaluated organoleptically and bacteriologically after storage for time up to 12 months. These foods were studied for usefulness in a frozen component feeding system offering a la carte selection at remote sites where prestocking of nonfrozen meal components is feasible. The results of this study indicate that the frozen foods were bacteriologically safe for consumption and, in general, organoleptically acceptable. Suggestions are offered for further development of this frozen component feeding system. Author (TAB)

N68-21017# School of Aerospace Medicine, Brooks AFB, Tex.
DESIGN CRITERIA FOR THE SPATIAL ORIENTATION TRAINER, JANUARY–JUNE 1967
Kent K. Gillingham, Robert L. Cramer, Patrick J. Dowd, and Frederick G. Collins Oct. 1967 23 p refs
(SAM-TR-67-90; AD-665840)

Spatial disorientation continues to cause at least 4% of the aircraft accidents in the Air Force. At the USAF School of Aerospace Medicine, the Spatial Orientation Trainer has been designed to help eliminate such accidents. The more deadly of the vestibular illusions of flight (namely, the Coriolis illusion, the oculogravic illusion, and the graveyard spin) can be reproduced and used to stress the pilot while he is performing a simulated mission in the trainer. Such exposure gives him practice in overcoming the sensory conflicts that result in disorientation and practice in proper aircraft control in spite of disorientation. The methods by which the illusions of flight are to be produced and the criteria upon which effectiveness of the trainer is to be judged are discussed in detail. Author (TAB)

N68-21018# Army Natick Labs., Mass. Clothing and Organic Materials Div.
ADVANCES IN THE DEVELOPMENT OF HEAD PROTECTION FOR AIRCRAFT CREWMEN
Abraham L. Lastnik Feb. 1967 7 p
(TR-67-53-CM; AD-665388)

The U.S. Armys new nylon fabric laminate flight helmet provides increased crash and ballistic protection over that of other

current U.S. military flight helmets. A newly developed retention device, based on an orthopedic sling for neck traction, assures retention of the helmet. A new visor of polycarbonate resin provides eye protection against impinging fragments. It resists shattering and penetration. Research studies reveal the feasibility of attenuating low frequency noise, at the ear, with relatively small volume ear cups. Author (TAB)

N68-21019# RAND Corp., Santa Monica, Calif.
A MODEL FOR CONTINUOUS NEUROELECTRIC AC ACTIVITY: THE ENCODING OF STIMULUS INTENSITY
R. J. MacGregor Feb. 1968 35 p refs
(P-3747; AD-665453)

The work applies the idea of large-amplitude depolarizations in dendritic regions to the intensity dependence of graded potentials in the vertebrate retina. The model assumes that membrane in dendritic regions of primary afferents is linear, that receptors excite primary afferents by a synaptic mechanism which is continuously active during stimulation, and that the magnitude of the permeability change depends linearly upon stimulus intensity. Comparison of the results with electrical data suggests that such a synaptic mechanism might represent the source of logarithmic intensity encoding. Psychophysical intensity data and possible applicability to other sensory modes are briefly discussed. Author (TAB)

N68-21251# Radio Corp. of America, Moorestown, N. J.
EXPERIMENTAL STUDY OF THE EFFECTS OF SURROUND BRIGHTNESS AND SIZE ON VISUAL PERFORMANCE Final Report, Mar. 1966–Mar. 1967
Fred H. Ireland, William Kinslow, Edwin Levin, and Donald Page Wright-Patterson AFB, Ohio AMRL Sep. 1967 57 p
(Contract AF 33(615)-3773)
(AMRL-TR-67-102; Rept.-67-101; AD-666045)

A visual display must often be used in a setting where the surrounding visual field is brighter than the background area within the display. Such use violates a common human factors recommendation that the brightness of the display surround should be equal to, or slightly less than, that of the background in the display itself. The purpose of this experiment was to determine, quantitatively, the degradation in visibility due to high surround brightness and thus to provide useful data for the display system designer. Measurements were made of the target-to-background contrast required for each of 5 Ss to determine, with 50% accuracy, the orientation of a light Landolt ring target centered on a darker circular background. The target gap subtended 1.93 minutes of arc. Background angular subtense was varied from 5 degrees to 45 degrees, background brightness from 0.17 to 18.43 millilamberts and surround-to-background brightness ratio from 0:1 to 100:1. A uniform surround, independently variable in brightness with respect to the background, filled the rest of the visual field. The scene was viewed monocularly with natural pupil. The contrast limen was found to vary directly with surround-to-background brightness ratio for ratios greater than one. The variation with background size was smaller than predicted by an equation for integrating the effects of point sources of glare. An apparent tendency for a slight increase in limen as the surround-to-background ratio decreased from 1:1 to 0:1 was not statistically significant. Results are described by equations, and a procedure for their practical application is illustrated. Author (TAB)

N68-21330# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF FORMING IN A MAN OPERATOR A HABIT OF TRACKING MOVING TARGET [K VOPROSU O FORMIROVANII U CHELOVEKA-OPERATORA NAVYKA SLEZHENIYA ZA DVIZHUSHCHEYSYA TSEL'YU]
G. V. Sukhokol'skiy 23 Aug. 1967 15 p refs Transl. into ENGLISH from the publ. "Problemy Obshchey i Inzhenernoy Psikhologii" Leningrad, Izd-Vo Leningradskogo Univ., 1964 p 80–89
(FTD-HT-66-543; AD-666064)

Cybernetics stimulated the large-scale use of the method of functional analogy which makes it possible to compare technical and human activity systems and express them in terms and symbols of a common control theory. Tracking is a common feature of numerous occupations, ranging from car driving to radar operation, and it can conveniently be analyzed by the method of functional analogy. The Human tracking system is discussed as the most interesting and highly efficient human activity because of the psychological control factor involved in its operation. The human tracking system is characterized by self-adjusting and self-correcting features which, apparently, is not always the case with technical systems. Experimental investigations of a human operator tracking a moving target revealed that the human tracking system is both oscillating and optimizing and capable of self-change and self-adjustment. It is considerably more complicated than the technical tracking systems, less accurate in certain specific functions but more stable and reliable. Author (TAB)

N68-21345# Mine Safety Appliances Co., Pittsburgh, Pa.
ENGINEERING RESEARCH PROTOTYPE DISTRIBUTION SYSTEMS FOR THERMALIBRIUM CLOTHING
Harry W. Austin, W. C. Hess, and Michael Theodore Natick, Mass. Army Natick Labs. Oct. 1967 45 p ref
(Contract DA-19-129-AMC-118(N))
(TR-68-21-CM; C+OM-37; AD-666226)

The results of material optimization, fabrication techniques and the fabrication of prototype air distribution systems for thermalibrium clothing are summarized. The engineering research effort was accomplished in two work phases. The initial phase was directed to the testing of materials, the development of fabrication techniques and the fabrication of two prototype systems for design verification testing. The second phase of the program involved the modification of patterns, and the fabrication of 34 air distribution systems on a modified production basis. The counter-flow system of distribution ventilating and/or conditioned air for protective clothing can be manufactured under standard production methods, using commercially available materials. Author (TAB)

N68-21485# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
INTENSITY OF THE RT READY-SIGNAL AS A DETERMINANT OF ADAPTATION LEVEL Interim Report
David L. Kohfeld 29 Jan. 1968 21 p refs
(AMRL-763; AD-666180)

Forty male Ss were given a simple reaction time (RT) test with four ready-signal conditions, 10 Ss in each condition. A fifth group of 12 Ss received all four ready-signal conditions in a counterbalanced order on consecutive days. The results indicated that a 90-db ready-signal produced the slowest mean RT, 30-db the fastest, 60-db intermediate, while a random combination of ready-signals with a mean of 60-db also produced intermediate RTs. It was concluded that the ready-signal served as an adaptation stimulus against which the response-signals were perceived. Author (TAB)

N68-21537*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FM HANDLING AND ANALOG-TO-DIGITAL CONVERSION OF BIOMEDICAL DATA FROM A 1,000-FLIGHT STUDY
Richard Carpenter and James Roman Washington Apr. 1968 12 p refs
(NASA-TN-D-4488) CFSTI: HC $3.00/MF $0.65 CSCL 06B

To collect, process, and analyze FM-recorded biomedical data from 1,000 flights in high performance aircraft and test vehicles, it was necessary to devise a handling facility that would prepare these data in a standard format for high speed computer processing. The handling system designed maintains the very high signal to noise ratio inherent in the original data acquisition equipment, provides pushbutton control for converting the medical

information into a standard format for digital processing at either four or eight times faster than the original record speed, and provides an effective number of quality control checkpoints. The system is described in detail, and system design considerations are discussed in relation to preventing data degradation in both FM handling and digital conversion. Approximately 1,400 hours of flight data have been processed by this system in less than 600 hours without loss of data integrity. This system is suitable for preparing biomedical data in standard format for digital processing, since the system design can easily be changed to accommodate nonstandard input formats. Author

N68-21538*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

RECORDING AND SIGNAL-CONDITIONING TECHNIQUES AND EQUIPMENT USED IN A 1,000-FLIGHT BIOMEDICAL STUDY

Richard Carpenter and James Roman Washington Apr. 1968 17 p refs

(NASA-TN-D-4487) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The NASA Flight Research Center recently concluded a biomedical monitoring program involving 1,000 flights in high performance aircraft by students of the USAF Aerospace Research Pilot School and by NASA aerospace research pilots. To permit accurate and reliable data acquisition of electrocardiogram (ECG), respiration rate, and normal acceleration, it was necessary to design and develop a means of reliably recording and transcribing flight medical data in a format compatible with computer reduction. Signal conditioners and interconnecting harnesses were designed and fabricated, and guidelines were established for the construction of a five channel analog tape recorder to record these data while the recorder is being carried on the pilot with minimum interference or discomfort. The equipment operated reliably and enabled satisfactory data acquisition of biomedical information both in extended biomedical instrumentation studies and in remote site medical monitoring. Author

N68-21541# North American Aviation, Inc., Columbus, Ohio.

OPERATIONAL STUDY OF PILOTS' VISUAL REQUIREMENTS Final Report

G. L. Burnett and L. M. Cunningham Johnsville, Pa. Naval Air Develop. Center 27 Feb. 1968 119 p refs Prepared in collaboration with the Naval Air Develop. Center

(Contract N00156-67-C-1100)

(NADC-AC-6803; AD-666116)

A preliminary study in which visual tasks, lighting utility, and ambient external light levels were examined on a time-task basis in an instrumented F4B aircraft. Methods included photometric and electrical recordings of the internal and external lighting environment of the aircraft. Also, pilot interviews, questionnaires, and direct observations of pilots in the F4B and other aircraft were employed. The results indicate that the methods employed are practical and that the visual tasks performed and ambient external lighting conditions are important determinants of lighting utility inside the cockpit. Author (TAB)

N68-21591# Naval Submarine Medical Center, Groton, Conn.

IMPROVING THE INTELLIGIBILITY OF HELIUM-SPEECH PRODUCED IN 13.13 TIMES NORMAL ATMOSPHERIC PRESSURES

R. L. Sergeant 8 Jan. 1968 9 p refs

(Rept.-68-1; AD-666297)

The study reports the results of efforts to improve the intelligibility of helium-speech when spoken at a simulated depth of 400 feet. These efforts included the taping of helium-speech and playing it back to listeners at half speed, also passing it through an equipment system (Varivox) which shifted frequencies downward by a factor of two while preserving real time. Higher intelligibility was obtained by employing a high-fidelity microphone and recording system. The intelligibility of this recording was greatly increased when the playback was slowed to one half speed. And a significant further increase in intelligibility was found when frequencies were shifted downward by the techniques inherent in the special equipment described. Author (TAB)

N68-21615# Texas Christian Univ., Fort Worth.

VERBAL ESTIMATION OF DISTANCE IN A SIMULATED SPACE ENVIRONMENT

Malcolm D. Arnoult, Bill R. Brown, Robert J. Vincent, and Sandra Tees Dec. 1967 32 p refs

Preliminary work has indicated that when Ss are given no information other than the real size of the target, verbal estimates of distance over the 200–5000 ft. range tend to have a median error of about 55%, with errors on individual trials running as high as 1000%. Two experiments investigated possible ways of improving the accuracy of verbal judgments. Effects due to kind of stimulus sequence (random or sequential), distance range, and the presence of verbal anchors were examined. In the first experiment the limits of the distance range being used were shown and identified to the Ss before each set of 10 judgments of randomly chosen distances. The use of these "anchors" reduced the median error to about 15%. A second experiment investigated the effect of sequential presentation of distances. The effect of anchors was about the same, but there were also some adaptation effects stemming from the sequential order of stimulation. Author

N68-21649# George Washington Univ., Alexandria, Va. Human Resources Research Office.

A CLASSROOM METHOD OF TRAINING AIRCRAFT RECOGNITION

Paul G. Whitmore, John A. Cox, and Don J. Friel Jan. 1968 44 p refs

(Contract DA-44-188-ARO-2)

(TR-68-1; AD-666093)

A prototype classroom training program was developed to train observers to recognize 16 jet fighter/attack aircraft to a criterion performance level of 95% correct recognition at five-second exposures. Previously developed experimental 35mm color slides were used for training. The training method placed emphasis on recognition feature learning, discrimination learning by means of similarity groupings of aircraft and simultaneous paired comparisons, cumulative practice and review, periodic testing, and remedial training. The 95% level was reached during the 16th 50-minute session, an average of one aircraft per session. On a transfer test using degraded images, the class averaged 61%--three times higher than a traditionally trained class in a previous pilot study. Most of this gain, however, may be due to increased training time. There was a substantial correlation between the transfer test and achievement, indicating that the recognition skill acquired during training would transfer to some other image condition. There are suggestions for improvement of the prototype program. Author (TAB)

N68-21676# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

ADAPTIVE CHARACTERISTICS OF THE HUMAN CONTROLLER OF THE TIME-VARYING SYSTEMS Final Technical Report, Dec. 1962–Dec. 1966

Jerome I. Elkind and Duncan C. Miller Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Dec. 1967 191 p refs

(Contract AF 33(657)-10124)

(BBN-1360; AFFDL-TR-66-60; AD-665455)

The studies are directed toward the development of models for one aspect of human controller adaptation--adaptation by trained controllers to sudden changes in controlled-element dynamics of single-axis compensatory control systems. The multi-phase model proposed consists of detection, identification, modification, and

optimization phases. Detailed models for all four phases of the adaptive process are presented and substantiated by experimental results. Author (TAB)

N68-21738# Human Factors Research, Inc., Santa Barbara, Calif.
VISUAL DETECTION OF POSITIVE VS NEGATIVE PIPS ON A RADAR PPI
C. H. Baker and William K. Earl Feb. 1968 13 p refs
(Contract Nonr-4120(00))
(TM-750-1; AD-666577)

Radar pip visibility thresholds were determined for conventional positive pips, and for negative pips, which were generated by applying a signal to the cathode of a CRT. It was concluded that at optimum phosphor brightness, pip visibility thresholds for positive and for negative pips, on both P7 and P19 phosphors, differ by less than one decibel. Author (TAB)

N68-21752# School of Aerospace Medicine, Brooks AFB, Tex.
FLAME PROTECTION AFFORDED MICE BY A NONCOMBUSTIBLE GARMENT IN 100% OXYGEN ATMOSPHERES
John J. Hargreaves and Frode Ulvedal Sep. 1967 23 p refs
(SAM-TR-67-91; AD-665833)

Thirty-nine mice, with hair clipped or unclipped, were clothed in a noncombustible garment, Beta cloth, and subjected to flame ignition in 100% oxygen atmospheres from 744 to 190 mm. Hg total pressure. The experimental results showed that the noncombustible garment afforded protection from combustion and flame propagation only if the animals hair had been previously clipped. Further studies should be conducted in an effort to assure mans protection. Author (TAB)

N68-21795# School of Aerospace Medicine, Brooks AFB, Tex.
FOURTEENTH ANNUAL CONFERENCE OF AIR FORCE BEHAVIORAL SCIENTISTS
Charles L. Jennings, ed. and Carlos J. G. Perry, ed. Dec. 1967 403 p refs Proc. held Lackland AFB, Tex., 18–20 Jan. 1967
(AD-665846)

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N68-21796# School of Aerospace Medicine, Brooks AFB, Tex.
THE ROLE OF THE FLIGHT SURGEON AND PSYCHIATRIST IN EVALUATION AND TREATMENT OF PSYCHIATRIC CASUALTIES FROM THE USAF SURVIVAL SCHOOL
James S. Robbins *In its* 14th Ann. Conf. of Air Force Behavioral Scientist Dec. 1967 p 28–42 (See N68-21795 11-05)

Background, objectives, and methods employed at the Air Forces survival school are surveyed, and the roles of the flight surgeon and the psychiatrist in the evaluation and treatment of psychiatric casualties are considered. Attention is given to psychiatric syndromes encountered, and four case histories are included to show the scope of difficulties. M.W.R.

N68-21797# School of Aerospace Medicine, Brooks AFB, Tex.
SSORT-TERM GROUP TREATMENT OF LATE-ADOLESCENT AIRMEN Followup Report
Allen W. Davis *In its* 14 Ann. Conf. of Air Force Behavioral Scientist Dec. 1967 p 43–56 refs (See N68-21795 11-05)

Short-term group therapy is discussed that enables late adolescent airmen to adjust to the demands of military life and complete their enlistments. The literature is reviewed and some clinical experiences are presented that indicate the success of group therapy methods. The advantages of beginning several groups with the intention of obtaining one long-term and well-motivated group are implied, although it is emphasized that the short-term group experiences can be used very effectively. M.W.R.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-20588# University Coll. of North Wales, Bangor.
AN INVESTIGATION OF NEW MATERIALS SUITABLE FOR THE FABRICATION OF SPACE CHARGE AMPLIFIERS
Final Technical Report, Oct. 1966–Sep. 1967
R. H. Tredgold Dec. 1967 16 p
(Contract DAJA37-67-C-0060)
(AD-665820)

Reasons for studying Boron Phosphide in the context of space charge conduction are discussed. The method adopted for the production of Boron Phosphide is described. Results involving runs with two reactant flasks are described. Various thin films were produced and also several allotropic forms of phosphorus, but no Borom Phosphide. Results involving runs with one reactant flask, using the addition compound PCl3.BBr3 are described. After several runs at gradually increasing temperatures, Boron Phosphide deposits were produced at a reaction temperature of 700 degrees C. Runs were performed to show that Boron Phosphide was produced not by thermal decomposition, but by the reduction of the addition compound, the reaction being Cl3P.BBr3 + 3H2 arrow BP + 3HCl + 3HBr. Present work on trying to reduce impurity contents and to produce epitaxy is discussed and the intended alternative methods of Boron Phosphide production described. Author (TAB)

N68-20592# Army Materials and Mechanics Research Center, Watertown, Mass.
AN EVALUATION AND IMPROVEMENT OF THE PERIODATE METHOD FOR THE DETERMINATION OF MANGANESE IN TITANIUM AND TITANIUM-BASE ALLOYS
Edna F. Jacobson Jan. 1968 25 p refs
(AMMRC-TR-68-01; AD-665394)

The periodate spectrophotometric method for manganese in titanium and titanium-base alloys in the ASTM Book, Part 32, prior to 1967, was considered to be too insensitive and slow. A method was developed to correct for these deficiencies, and is described in this report. This and another method were tested by the ASTM Titanium Task Force and the AMMRC method was selected to replace the existing standard photometric method in ASTM. This report shows the results obtained by the Titanium Task Force and a statistical study of the data. The detailed analytical method developed at AMMRC is appended to the report. Author (TAB)

N68-20594# Junta de Energia Nuclear, Madrid (Spain). Div. de Quimica.
MEASUREMENT OF ALUMINUM, IRON AND SILICON IN FLUORITE BY DIRECT READING SPECTROMETER [DETERMINACION ESPECTROQUIMICA DE LECTURA DIRECTA DE ALUMINIO, HIERRO Y SILICIO EN FLUORITA]
Miguel Roca Oct. 1966 16 p refs In SPANISH; ENGLISH summary
(JEN-185-DQ/I-62) CFSTI: HC $3.00/MF $0.65

A quantitative method for spectral measurement of Al, Fe and Si in fluorite samples using a direct reading spectrometer was developed. Excitation was produced by a 10 amp. DC arc, placing the samples in a 6.35 mm diameter graphite electrode with crater of 5 mm diameter and 2.5 mm depth. A comparative study of vaporization and excitation of undiluted and diluted samples was made. For diluted samples graphite powder in the ratios 1:1, 1:4 and 1:9 was used ad diluent and best analytical results were obtained with the 1:9 ratio. Ag, Ca, Co, Cr, Mo and Sn were tested as internal standards. The interaction between the three elements Al, Fe and Si was found to be insignificant. The need to use standard samples having natural fluorite rather than laboratory obtained Ca F2 as base material was also demonstrated. Author (ESRO)

N68-20604# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
THE DIELECTRIC RELAXATION SPECTRA OF WATER, ICE, AND AQUEOUS SOLUTIONS AND THEIR INTERPRETATION. 3: PROTON ORGANIZATION AND PROTON TRANSFER IN ICE
Arthur R. von Hippel Jan. 1968 63 p refs
(Contract N00014-67-A-0204-0003)
(TR-3; AD-665670)

After a short consideration of the phases and proton arrays of ice, the experimental facts on orientation polarization and conduction are summarized and the underlying molecular processes of intramolecular and intermolecular proton transfer identified. The new approach links dielectric relaxation spectroscopy to infrared spectroscopy. Author (TAB)

N68-20606# Junta de Energia Nuclear, Madrid (Spain). Div. de Quimica.
SPECTROSCOPIC ANALYSIS OF URANIUM-MOLYBDENUM ALLOYS [ANALISIS ESPECTROGRAFICO DE ALEACIONES URANIO-MOLIBDENO]
Migvel Roca Jan. 1967 14 p refs In SPANISH; ENGLISH summary
(JEN-187-DQ/I-65) CFSTI: HC $3.00/MF $0.65

A spectrographic method of analysis has been developed for uranium-molybdenum alloys containing up to 10% Mo. The carrier distillation technique, with gallium oxide and graphite as carriers, is used for the semiquantitative determination of Al, Cr, Fe, Ni and Si, involving the conversion of the samples into oxides. As a consequence of the study of the influence of the molybdenum on the line intensities, it is useful to prepare only one set of standards with 0.6% MoO_3 Total burning excitation is used for calcium, employing two sets of standards with 0.6 and 7.5 MoO_3. A carefully controlled conversion of the samples into oxides, at 550° is necessary for the quantitative determination of molybdenum, to avoid losses of Mo and to get the total conversion of the uranium into U_3O_8 The samples are diluted with graphite (1:9), using cobalt as internal standard, and d.c. arc total burining excitation. The standard deviation is ±8% and the results are in good agreement with those obtained by chemical methods. Author (ESRO)

N68-20607# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SODIUM, MAGNESIUM, CHLORINE, POTASSIUM, AND CALCIUM. PART 6: CALCIUM
M. K. Drake Nov. 1967 156 p refs
(Contract DA-18-035-AMC-730(A))
(GA-7829, Pt. 6; NDL-TR-89-6; AD-665364)

An investigation was made of the neutron interaction probabilities with the element calcium. Sets of recommended total

and partial neutron cross sections were prepared. The energy and angular distributions of the secondary neutrons are given. Also, gamma ray production cross sections were obtained as well as energy and angular distributions of the secondary gamma rays. In general, the recommended data were based on experimentally measured data. However, where no experimental data were available, the recommended cross sections were obtained using model calculations. Author (TAB)

N68-20611 Iowa State Univ. of Science and Technology, Ames.
A MEASUREMENT OF THE HEAT CAPACITY OF $CaMg_2$ AND A CALCULATION OF THE COHESIVE ENERGY OF $CaMg_2$
Joseph Edward Davison (Ph.D. Thesis) 1966 45 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5580

The heat capacity of $CaMg_2$ has been measured from 4.9°K to 286.6°K with an adiabatic calorimeter. The standard entropy of $CaMg_2$ was evaluated from these data to obtain a value of 8.27 cal/gm-atom/K° at 298.1°K. This value was combined with the existing entropy values to yield a value of $-.25 \pm .06$ cal/K°/gm-atom for the standard entropy of formation of $CaMg_2$ at 298.1°K. The heat content of $CaMg_2$ was measured from 273°K to 670°K. These data were combined with the heat capacity information and existing data for the standard enthalpy for formation of $CaMg_2$ and the heat capacities of the elements to obtain a value of −3.19 Kcal/mole for the standard enthalpy of formation at 0°K. The cohesive energies of $CaMg_2$, $SrMg_2$, and $BaMg_2$ were evaluated in the framework of the free electron theory of metals. The ground state energies of the valence electrons of the compounds were approximated as the arithmetic mean of the ground state energies of the appropriate elements. Dissert. Abstr.

N68-20624# Cornell Univ., Ithaca, N. Y. Materials Science Center.
ELECTRON SPIN SUSCEPTIBILITIES OF THE LIQUID BINARY ALKALI ALLOYS
Jack Alan Kaeck (Ph.D. Thesis) Jan. 1968 91 p refs
(Contract DA-31-124-ARO(D)-407)
(MSC-854; AROD-6028-6-P; TR-4; AD-665324)

Properties of the conduction electron system in the liquid binary alkali metal alloys were investigated. Experimental values are given of the Knight shifts of both constituents of a binary alloy, when possible, for those alloys not previously studied. As the binary alloys of sodium, potassium, rubidium and cesium with one another are completely miscible in the liquid state, the entire concentration range for all alloys was covered. The Knight shifts were then interpreted to give the electron spin susceptibilities of those alkali metals for which the spin susceptibility has not yet been reported. These susceptibilities were then used to obtain experimental values of other interesting quantities. Measured values of the density of states at the Fermi surface for the pure metals were obtained. Finally these measured densities of states and the measured specific heats were combined to give measured values of the electron-phonon interaction contribution to the thermal effective mass of the electrons in the pure metals. TAB

N68-20627 Stanford Univ., Calif.
A STUDY OF THE Ga–As–Zn SYSTEM WITH APPLICATIONS TO THE DIFFUSION OF Zn IN GaAs
Kwang Kuo Shih (Ph.D. Thesis) 1966 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-4435

The dependence of solubility and diffusion coefficient on arsenic pressure was investigated to see whether the interstitial–substitutional model previously proposed by other investigators for Zn in GaAs is justified. In order to determine the arsenic vapor pressure during diffusion, the phase equilibria among Ga, As, and Zn were considered. The Ga–As–Zn ternary phase diagram was studied in detail for particular relevance to the diffusion problem. Based on the interstitial–substitutional model, the theoretical results of average conductivity, solubility, and diffusion coefficient for Zn in GaAs as a function of arsenic pressure were derived. The good agreement obtained between the experimental data and the theoretical predictions justifies the interstitial–substitutional model. Dissert. Abstr.

N68-20633 Utah Univ., Salt Lake City.
KINETICS OF THE $CaCO_3$–SiO_2 SOLID STATE REACTION
Max Romney Montierth (Ph.D. Thesis) 1967 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-6394

This investigation was initiated in order to determine the mechanism of the reaction between quartz and calcite. The proposed reaction of $2CaCO_3 + SiO_2 = Ca_2SiO_4 + 2CO_2$ was followed in the 700° to 850°C temperature range by measurement of the sample weight loss with time resulting from the CO_2 evolution during reaction. Weight loss calculations were made from extension measurements of a quartz spring. The materials used for sample preparation were fused quartz, Min-U-Sil, reagent grade calcite, Iceland spar optical quality calcite, and high purity calcite and μ-$CaCO_3$. The samples used were comprised of 10 volume per cent coarse particles of one reactant in a 90 v/o matrix of fine particles of the other reactant, and were pressed into thin wafers at 50,000 psi pressing pressure. The reaction temperature was maintained below the equilibrium CaO–$CaCO_3$ temperature corresponding to 1 atm CO_2 pressure in order to prevent $CaCO_3$ decomposition. Dissert. Abstr.

N68-20634# Aerospace Corp., El Segundo, Calif. Lab. Operations.
COMPUTED ACTIVATION ENERGIES FOR REACTIONS OF O_2, N_2, NO, N_2O, NO_2, CO_2, AND CO_2.
Stanley W. Mayer Dec. 1967 23 p refs
(Contract F04695-67-C-0158)
(TR-0158(9210-02)-2; SAMSO-TR-68-51; AD-665473)

A method is described for calculating the activation energies of bimolecular reactions of such multivalent gaseous compounds as O2, N2, NO, N2O, NO2, CO, and CO2. It is also applicable to the monatomic reactants O, N, and H and to the OH radical. The method uses relationships between dissociation energy, bond length, vibrational wavenumber, and bond order. It avoids the use of adjustable parameters. The agreement between calculated and experimental activation energies is very good when spin conservation in the transition state is considered in the computation procedure. A convenient rule has also been formulated that predicts the activation energy will be negligible in bimolecular reactions between radicals when the transition-state formula corresponds to that of a compound having stable bonds. No exceptions to this rule have been found. The method is applicable to computing rates needed for nonequilibrium calculations of propellant performance and of reentry behavior. Author (TAB)

N68-20644 Ohio State Univ., Columbus.
SPECTRAL AND MAGNETIC PROPERTIES OF SOME TETRAGONAL MACROCYCLIC COMPLEXES OF NICKEL (2)
Jack Lee Karn (Ph.D. Thesis) 1966 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6331

There is an extensive body of theoretical speculation regarding the effects of tetragonal distortion on the properties of 6-coordinate nickel(II) complexes. The object of this investigation was to test these predictions by studying the spectral and magnetic properties of an appropriate series of tetragonal nickel(II) complexes. The usual problem of obtaining a suitable series of complexes of this labile ion was circumvented by the use of macrocyclic nickel(II) complex cations. With these systems, series of tetragonal derivatives having constant planar fields but varying axial fields are readily obtained through the use of axially coordinated anions of varying donor ability. Nickel(II) complexes of cyclic tetraamines such as hexamethyl-tetraazacyclotetradecane were employed. In the

characterization of the complexes utilized in this study, a number of unusual structures and solvation properties were observed, which arise from the macrocyclic nature of the planar ligands. These effects are described in detail. All pertinent infrared spectra are included. Dissert. Abstr.

N68-20660 California Univ., Berkeley.
ALKALINE HYDROLYSIS AND OXIDATION OF HYDROXYLAMINE-N-SULFONATE ION
Martin Nicholas Ackermann (Ph.D. Thesis) 1966 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-4986

The hydroxylamine-N-sulfonate ion, $HONHSO^-_3$, has been found to undergo two reactions, hydrolysis and oxidation. The kinetics and mechanism of both have been investigated. The products of the alkaline hydrolysis of $HONHSO^-_3$ are sulfite and nitrous oxide. The form of the kinetic dependence on $[OH^-]$, and the observation that the N_2O does not contain excess O^{18} when the reaction is carried out in water enriched with O^{18}, are consistent with a mechanism involving cleavage of the conjugate base rather than nucleophilic attack on nitrogen. The kinetic dependence on $[SO^{--}_3]$ is consistent with a mechanism with two pathways one of which involves an intermediate species than can rapidly re-react with sulfite. It is suggested that one or the other tautomers of nitroxyl, HNO or HON, is the intermediate. Dissert. Abstr.

N68-20674 Pennsylvania State Univ., University Park.
THE REACTIONS OF ATOMIC CARBON WITH HYDROCARBON SUBSTRATES
Robert Ralph Engel (Ph.D. Thesis) 1966 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-5913

The atomic carbon was produced using a low-intensity carbon arc in high vacuum. It was found that this method provided a mixture of ground state (^3P) and metastable excited state (^1D and ^1S) carbon atoms available for reaction. Ground state (^3P) atomic carbon was found to react with olefins to form spiropentanes. Its addition using cis- and trans-2-butene was stereospecific in the first step and non-stereospecific in the second step, in accord with the triplet nature of the species. Its reactivity sequence with olefins, showing a high preference for 1,3-butadiene in the non-stereospecific step. ^1D carbon atoms reacted with olefins to form spiropentanes as well as a number of other diolefin adducts which were unsaturated. The ^1S carbon atoms were found to react with olefins by insertion into the double bond leading to allenes. With saturated hydrocarbons they reacted by insertion into a carbon–hydrogen bond yielding a mono-alkyl carbene which could further react. Dissert. Abstr.

N68-20682 Illinois Univ., Urbana.
GAS LIQUID CHROMATOGRAPHY OF VOLATILE INORGANIC FLUORIDES, PART 1. THERMODYNAMICS OF SOLUTION OF SELECTED METAL HALIDES VIA GAS LIQUID CHROMATOGRAPHY, PART 2
Richard Leroy Fisher (Ph.D. Thesis) 1966 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-6609

Qualitative and quantitative methods are presented for the elution of MoF_6, WF_6, ReF_6, OsF_6, UF_6, SF_6, SeF_6, TeF_6, VF_5, TaF_5, NbF_5, AsF_5, SbF_5, and AsF_3 from a gas chromatographic column. Instrumentation is described for the *in situ* preparation of many of these compounds by reaction of fluorine with milligram amounts of metals, their alloys, oxides, carbides, sulfides, and salts. MoF_5, WF_6, UF_6, and ReF_6 were determined quantitatively by this method. Results for the analyses of these materials show good precision and accuracy, and in general they are more rapidly obtained than for methods involving conventional chemical analysis. The thermodynamics of solution of MoF_6, WF_6, AsF_3, $AsCl_3$, and TaF_5 in different molecular weight polymers of polymonochrotrifluoroethylene was also studied. Results indicate that no specific solute-solvent interactions are involved other than dispersion and dipole-induced dipole forces. Dessert. Abstr.

N68-20701 Western Reserve Univ., Cleveland, Ohio.
AMIDO COMPLEXES OF MOLYBDENUM (6)
Till Justus Nathan Peters (Ph.D. Thesis) 1966 188 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-4618

This study involved the preparation and characterization of several amido complexes of dioxodichloromolybdenum(VI). The starting material used in the preparation of the complexes was dioxodichloromolybdenum(VI) hydrate. This investigation included a study of the starting material and its deuterated analog. The conclusion drawn was that this compound is properly formulated as $MoO_2Cl_2 \cdot H_2O$ and not as $MoO(OH)_2Cl_2$. The amido complexes fit the general formula, $MoO_2Cl_2L_2$ (L = amide, dimethylsulfoxide, or triphenylphosphine oxide) and are unusual in their stability. These complexes are all high-melting, air-stable, slightly photosensitive, compounds. The amide-molybdenum bond is through the oxygen of the ligand. Osmometric and conductance measurements in acetonitrile indicate that solvolytic dissociation and, less significantly, ionization, are important processes that occur in (non-aqueous) solutions of the complexes. Dissert. Abstr.

N68-20707 California Univ., Riverside.
STATISTICAL THERMODYNAMICS OF POLYPHENYLS AND HEAT CAPACITIES IN CRITICAL PHASE TRANSITION REGIONS. (PARTS 1 AND 2)
Jack Douglas Opdycke (Ph.D. Thesis) 1966 93 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-5857

Molar volumes and the isothermal compressibilities were measured for biphenyl and for *o*-, *m*-, and *p*-terphenyl in the solid and liquid ranges from room temperature up to 350°, 450°, 400°, and 400°C respectively; and up to 170 atm. pressure to provide data for testing theoretical statistical thermodynamic models for simple polymers. The experimental results are discussed in terms of the predictions of equations of state of the Tait and van der Waals type and in terms of the recent statistical thermodynamic models of Flory, et al., and Prigogine, et al. The later models are in general adequate for representation of the experimental data. Heat capacity versus temperature curves were obtained for the xenon liquid-vapor critical region and for the cyclohexane-aniline critical mixing region. The curves are more complex than can be entirely explained by the theoretical models presently being applied to the critical region. The upper branch of the heat capacity function is similar to a normal lambda curve but contains a pronounced minimum within the first degree in each case. Dissert. Abstr.

N68-20708 Oregon State Univ., Corvallis.
APPLICATION OF THE LEAST SQUARES CRITERION TO THE DETERMINATION OF MOLECULAR COMPLIANCE CONSTANTS
Robert Stanley Ottinger (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-5644

The development of a least squares model for the determination of compliance constants from various combinations of vibration frequency, mean square amplitudes of vibration and centrifugal distortion data is discussed. The resultant model is applied to frequency and mean square amplitude data for NO_2 and N_2O_4 and to frequency and centrifugal distortion data for SO_2. For NO_2 and SO_2 it was possible to use various combinations of data and weight matrices so that some statements could be made regarding the utility of the model. A recently developed theory concerning the anharmonicity effect due to the presence of the low frequency torsion mode in X_2Y_4 type molecules was applied to N_2O_4 giving results which point to a plausible explanation for some of the unusual bands observed for this type molecule. Dissert. Abstr.

N68-20728# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
TEMPERATURE DEPENDENCE OF CHEMILUMINESCENT REACTIONS. VOLUME 2: THE NITRIC OXIDE AFTERGLOW
Rolf W. F. Gross and Norman Cohen Nov. 1967 32 p refs
(Contract F04695-67-C-0158)
(TR-1001(2240-20)-6, V. 2; SSD-TR-67-157, V. 2; AD-665867)

Using a glow discharge shock tube, measurements were made of the temperature and density dependence of the beta, gamma, and delta bands for the NO recombination afterglow. The absolute rate constants were determined for each of the vibrational transitions of the three bands at room temperature. Results for the total band intensities are given. TAB

N68-20748# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.
ICOSAHEDRAL CARBORANES. 13: HALOGENATION OF P-CARBORANE
John F. Sieckhaus, Nick S. Semenuk, Thomas A. Knowles, and Hansjuergen Schroeder Feb. 1968 23 p refs Submitted for publication
(Contract Nonr-3395(00))
(TR-39; AD-665306)

A method for the preparation and purification of substantial amounts of p-carborane is described. Chloro-, bromo- and iodo-p-carboranes were obtained via direct halogenation. The various halogenated species were separated by either column or vapor phase chromatography. In the chloro-p-carborane series, the mono-, nona- and decachlorinated compounds are individual species; the others occur as mixtures of geometrical isomers. Separation of the latter was accomplished by high resolution VPC using capillary column techniques. Interpretation of the chromatograms of these chlorinated derivatives proved consistent with the formation of all possible isomeric species in approximately those quantities which would be predicted on a statistical basis. None of these isomers was physically isolated, however. In contrast, partial fractionation of the dibromo- and diiodo-p-carborane isomer mixtures proved possible by common laboratory techniques. Author (TAB)

N68-20775# Georgia Univ., Athens. Dept. of Chemistry.
TRANSITION-METAL COMPLEXES CONTAINING NITROGEN, PHOSPHORUS, OR SULFUR Final Report, 1 Jan. 1964–31 Dec. 1967
R. B. King 31 Dec. 1967 36 p refs
(Grant AF-AFOSR-1211-67)
(AFOSR-68-0343; AD-665429)

The results of four years work are outlined. Major advances were achieved in the following areas: (1) New arylazo derivatives of molybdenum, (2) new cyclopentadienyl metal nitrosyl derivatives of molybdenum and manganese, (3) new isonitrile derivatives of chromium, molybdenum, and tungsten, (4) trisacetonitrilemetal tricarbonyls of chromium, molybdenum and tungsten as preparative reagents, (5) novel complexes from trifluoroacetonitrile, (6) cyclic acyl derivatives with organonitrogen and organosulfur ligands, (7) metal carbonyl complexes of unsaturated phosphines, (8) new pi-CH3SCH2 derivatives, (9) new complexes with terminal and with bridging methylthio groups, (10) new complexes obtained from bis(trifluoromethyl)dithietene and disodium cis-ethylenedithiolate, (11) new chemistry of the metal carbonyl anions, (12) preparation and reactions of cyclopentadienyl-diiodocarbonylcobalt, (13) new pi-pentamethylcyclopentadienyl derivatives of various metals, and (14) new polynuclear cyclopentadienylmetal carbonyls of iron and cobalt. Author (TAB)

N68-20781 Illinois Univ., Urbana.
ELECTRON SPIN RESONANCE OF TRIVALENT NEODYMIUM PAIRS IN ANHYDROUS LANTHANUM TRICHLORIDE AND LANTHANUM TRIBROMIDE
Keith Lamar Brower (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6570

Measurements of the electron spin resonance spectra of first- and second-neighbor Nd^{3+} pairs in $LaCl_3$ and $LaBr_3$ were made at 4.2°K and 9 kMc–sec on crystals doped with enriched even-even isotopes of neodymium. The observed spectra can be described in terms of a spin Hamiltonian containing a Zeeman term and a traceless coupling tensor A_{ij} between two effective spins each of magnitude 1/2. About 5,000 resonances due to allowed and forbidden transitions within these triplet levels were observed and fit to this Hamiltonian for various orientations of the magnetic field with respect to these crystals. It was necessary to diagonalize the spin Hamiltonian in order to analyze the spectra associated with the first-neighbor Nd^{3+} pairs. The observed symmetry of the second-neighbor interaction tensors in these two salts suggests that the halide ions play an important role. By removing the dipolar contributions to A_{ij}, quantitative results regarding the nature of the nondipolar spin-spin interaction are obtained. Dissert. Abstr.

N68-20783 Illinois Univ., Urbana.
GROUP 1 AND 3 ORGANOMETALLIC EXCHANGE REACTIONS
Kenneth Charles Williams (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-6775

The ^1H and ^7Li n.m.r. spectra of ether solutions of the following mixtures were examined in the temperature range +30 to −60°C: $LiCH_3$–$LiB(CH_3)_4$; $LiCH_3$–$LiAl(CH_3)_4$; $LiCH_3$–$LiIn(CH_3)_4$; $LiAl(CH_3)_4$–$LiB(CH_3)_4$; $Al(CH_3)_3$–$LiAl(CH_3)_4$; $Al(CH_3)_3$–$LiB(CH_3)_4$; LiC_2H_5–$LiAl(C_2H_5)_4$; LiC_2H_5–$LiGa$–$(C_2H_5)_4$; $LiAl(C_2H_5)_4$–$LiGa(C_2H_5)_4$. In addition the ^7Li and ^1H spectra of the pure components in ether were also obtained. Alkyl group exchange is slow on the n.m.r. time scale in all mixed systems except for $Al(CH_3)_3$–$LiAl(CH_3)_4$. The rate-determining process in this system appears to be formation of solvent-separated ion pairs from contact ion pairs: $Li^+, Al\text{–}(CH_3)_4^- \rightarrow Li^+ || Al(CH_3)_4^-$. The Arrhenius activation energy is estimated to re 9.1 ± 1 kcal/mole. Dissert. Abstr.

N68-20789 Illinois Univ., Urbana.
He^3INDUCED REACTIONS IN NICKEL AND ZIRCONIUM
David Edwin Rundquist (Ph.D. Thesis) 1966 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-6719

The stable isotopes of nickel and zirconium, with the exception of Zr^{96}, have been bombarded with a 25 Mev He^3 beam. Elastic, inelastic, and (He, α) absolute cross sections have been measured. The (He^3, α) angular distributions for l-transfers of one and three were found to contain J-dependent effects. Least-squares, optical-model fits were obtained to the observed elastic scattering data. Collective-model, distorted-wave Born approximation (DWBA) calculations were performed for the inelastic transitions. Deformation parameters were extracted from the data. Finite-range, non-local potential corrections were included in the DWBA (He^3, α) analysis by the use of the local energy approximation. Spectroscopic factors were extracted. Some discussion on the merits of the (He^3, α) reaction as a general nuclear spectroscopic tool is presented. Dissert. Abstr.

N68-20797# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROTATIONAL STRUCTURE OF THE SPECTRUM FOR THE GENERATION OF HYDROGEN AND DEUTERIUM MOLECULES [VRASHCHATEL'NAYA STRUKTURA SPEKTRA GENERATSII MOLEKUL VODORODA I DEYTERIYA]
I. N. Knyazev 18 Aug. 1967 14 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (Moscow), v. 3, no. 6, 1965 p 510–515
(FTD-HT-66-521; AD-665704)

The mechanism responsible for pulsed laser action on rotational levels of H2 and D2 in which excitation during the initial stage

of the pulse discharge occurs by direct electron impact from the ground state is analyzed. It is shown that in addition to the Fransk-Condon principle, it is also necessary to take into account certain features of rotational level population associated with the conservation of the molecular rotational state excited by electron impact. The peculiarities of a laser rotational spectrum (preferential laser action on P(2) and P(3) lines of H2 and D2, respectively, the great difference in laser intensity of the P(2) and P(4) lines of H2, laser oscillation solely on orthomodifications) are explained qualitatively on the basis of the proposed excitation mechanism. TAB

N68-20799# Bhabha Atomic Research Centre, Bombay (India).
SPECTROGRAPHIC DETERMINATION OF ALLOYING ELEMENTS IN ZIRCALOYS
T. S. Krishnan, Premkumar Dhall, and K. R. Pathare 1967 10 p refs
(BARC-312) CFSTI: HC $3.00/MF $0.65

A spectrographic method has been developed for the determination of alloying elements in zircaloys in the following concentration ranges: chromium and iron 0.025–0.2%; nickel 0.0125–0.1% and tin 0.25–2%. The sample in the form of oxide is mixed with zinc oxide and graphite in equal proportions and 10 mgs of this mixture is burnt in a direct current arc of 10 amps. Using cobalt as the internal standard, the standard deviations calculated from spectra taken on different plates on different days range between ±3 to 6% for the different elements. Author

N68-20815 Mississippi Univ., University.
VIBRATIONAL RELAXATION IN CARBON DIOXIDE–WATER VAPOR, HELIUM AND HYDROGEN MIXTURES
James Waller Lambuth Lewis (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6446

Sound absorption and velocity measurements were made employing the tube method on carbon dioxide/water vapor and helium mixtures over the temperature range 24 to 195°C. The concentrations of water vapor employed varied from 0.2 to 0.4 mole per cent, and helium concentrations were in the range 1 to 11 mole per cent. For both water vapor and helium mixtures the maximum relaxation intensity absorption per wavelength agreed within experimental error with that predicted by a single relaxation time, series deactivation process of the CO_2 molecule for which infinitely fast coupling between the valence and deformation modes was assumed. For both water vapor and helium mixtures the experimental zero frequency sound velocity agreed within the experimental error with that predicted by theory. Vibrational relaxation times τ for the mixtures were obtained from both absorption and dispersion curves, and for both water vapor and helium mixtures, at each temperature, $1/\tau$ plotted versus the impurity mole fraction X displayed a linear relation, thereby demonstrating the validity of the binary collision assumption. Dissert. Abstr.

N68-20842 Arizona Univ., Tucson.
DIRECT CALORIMETRIC DETERMINATION OF HEATS OF FORMATION OF SOME METAL CHELATES
George Gutnikov (Ph.D. Thesis) 1967 123
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3956

A simple, twin-differential calorimeter capable of determining the heats of chelation in highly dilute solutions was designed and constructed. The heats of reactions of several chelating agents containing oxygen and sulfur donor atoms with a number of transition and heavy metal ions were obtained, and the corresponding formation constants were calculated. The chelating agents studied were 8-quinolinol, 2-methyl and 4-methyl-8-quinolinol, 8-quinolinol-5-sulfonic acid, quinoline-8-thiol, 2-methylquinoline-8-thiol, and 2,4-pentanedione; the metal ions included Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, and Pb^{2+}. Reactions were generally performed in an aqueous 50 volume % dioxane-0.1 M $NaClO_4$ medium, or in aqueous 0.1 M $NaClO_4$. In contrast to previous studies, considerable regularity was found in the entropy changes of chelation for the 8-quinolinols. The heats of chelation for the quinoline-8-thiols showed that the metal sulfur bonds are stronger than the metal–oxygen bonds. The reversal of the usual stability order (Ni > Zn) is due to a more favorable entropy change, which was attributed to the formation of a tetrahedral zinc chelate. Dissert. Abstr.

N68-20853 Utah Univ., Salt Lake City.
THE ADHERENCE OF CUPROUS OXIDE TO COPPER
Grant Barg Weed (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6393

Wetting experiments involving molten copper and dilute copper alloys on cuprous oxide (Cu_2O) were conducted. Contact angles were measured by means of the sessile drop technique for high-purity copper, oxygen-free high-conductivity copper (O.F.H.C.), and coppers containing small amounts of nickel, phosphorous, and arsenic. All of the coppers, with the exception of that bearing the highest nickel content, 1.0%, gave lower contact angles than that observed for the high-purity copper. Strength tests were also performed on oxidized samples of the various coppers to determine the relative adherence of the oxide. The adherence appeared to be controlled either by the formation of a second phase in the oxide, the state of compressive stress in the oxide, or both. There were strong indications that the oxide layers in a high state of compression were more adherent than those in which the stresses were relieved. Dissert. Abstr.

N68-20854 Maryland Univ., College Park.
NEW ABSORBENT-REFRIGERANT COMBINATIONS FOR AIR CONDITIONING ABSORPTION REFRIGERATION
Edwin Ellsworth Maust, Jr. (Ph.D. Thesis) 1966 474 p
Available from Univ. Microfilms: HC $21.40/MF $6.05 Order No. 67-6281

The objective of this research was to find other absorbent-refrigerant combinations, preferably with water as the main refrigerant, that are better than $LiBr–H_2O$ in one or more respects. The first new system extensively investigated in this work was a (mixed salt)-water system in which the mixed salt was 80% LiBr and 20% LiCl on a dry salt weight basis. The ebulliometer measurements on these solutions indicated that they would give a moderate, but significant, improvement over $LiBr–H_2O$ solutions as absorbents for water. The second system investigated in some detail was the ternary: LiBr-ethylene glycol-H_2O. The results obtained indicate that this system does have a great potential as a competitor for $LiBr-H_2O$ and, in particular, may make it feasible to construct an absorption machine which is completely air-cooled. Dissert. Abstr.

N68-20882 Pennsylvania State Univ., University Park.
TEMPERATURE DEPENDENCE OF HYPERSONIC VELOCITY IN LIQUIDS
Amos Graham Hollinger (Ph.D. Thesis) 1966 39 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5924

Hypersonic velocities were determined to within 1.0% in nine liquids (CCL_4 CS_2, acetone, benzene, nitrobenzene, 1-octanol, aniline, ethylene glycol, and glycerine). The measurements were made at temperatures between −30°C and 150°C at acoustic frequencies from 3 to 11 Gc/sec. Velocities were obtained from the Brillouin spectra produced by a 300 milliwatt He–Ne laser. Significant velocity dispersion was observed in 7 of the 9 liquids. Dissert. Abstr.

N68-20921# Bhabha Atomic Research Centre, Bombay (India).
CORRELATION OF DIFFUSION DATA WITH AN ATOMIC BOND PARAMETER
S. P. Ray, B. D. Sharma, and G. P. Tiwari 1967 16 p refs
(BARC-302) CFSTI: HC $3.00/MF $0.65

The possibility of a correlation between the activation energy of self-diffusion and an atomic bond parameter involving cohesive energy and atomic volume has been discussed. It is shown that the ratio of Q_{self} to the bond parameter represents the activation volume of self-diffusion. The diffusion of transition and non-transition elements in noble metals has also been discussed. It is suggested that the difference in the activation energy of solute and self-diffusion arises due to a change in the local bond parameter. The change can occur if non-transition solutes 'in solution' contribute valence electrons to increase the Fermi energy of the solvent. Such an increase reduces the binding energy which in turn decreases the activation energy of diffusion. In the case of transition elements the process is reversed. Author

N68-20937# Naval Ordnance Lab., White Oak, Md.
THERMODYNAMIC PROPERTIES OF POLYMETHYLACRYLATE AND POLYMETHACRYLIC ACID
R. W. Warfield and M. C. Petree 29 Dec. 1967 14 p refs
(NOLTR-67-171; AD-665486)

Using published specific heat data, the entropy, enthalpy, and Gibbs free energy of polymethylacrylate (PMA) and polymethacrylic acid (PMAA) were calculated over the temperature range 0 to 210K. The encraty, Cp/T vs. T, calculated for both PMA and PMAA, exhibits a maximum at about 70K. Neither of these systems exhibits any transition over the temperature range considered. Author (TAB)

N68-20945# California Univ., Berkeley. Lawrence Radiation Lab.
TEMPERATURE DEPENDENT PROPERTIES OF DINUCLEOSIDE PHOSPHATES
Robert Charles Davis (Ph.D. Thesis) Nov. 1967 284 p refs
(Contract W-7405-ENG-48)
(UCRL-17966) CFSTI: HC$3.00/MF$0.65

The temperature dependent properties of dinucleoside phosphates were studied to obtain information about single-strand nearest neighbor interactions in ribonucleic acids. Optical rotatory dispersion, ultraviolet absorption, and proton magnetic resonance were used to probe the thermal disordering of these compounds. Two models were used to analyze the data. For the two-state model, a molecule was considered to be in either the ordered or disordered form with no permissible conformations between them. For the oscillating dimer model, the two bases of a dinucleoside phosphate were constrained by a single torsional harmonic potential. The properties of dinucleoside phosphates in dilute salt solutions (from 0°C to 90°C) were compatible with either model. Calculations of the potential energies of conformations of nucleic acid fragments were also carried out. Molecules were considered to consist of rigid sections (e.g., a base) connected by single covalent bonds about which rotation could take place. Interatomic potentials included charge–charge, charge–polarizability, polarizability–polarizability, and steric repulsion terms. These calculations indicated that pyrimidine nucleosides are all in the anti conformation while purine nucleosides may be either syn or anti. Energetically stable torsional angles calculated for larger systems generally agreed with those found in polynucleotide fiber structures. NSA

N68-20967# Bhabha Atomic Research Centre, Bombay (India).
INVESTIGATION OF MATERIALS AND METHODS FOR FIXATION OF LOW AND MEDIUM LEVEL RADIOACTIVE WASTE IN STABLE SOLID MEDIA Progress Report, 1 Aug. 1966–31 Jul. 1967
R. C. Rastogi, J. D. Sehgal, and K. T. Thomas 1967 66 p refs
(Contract IAEA-261/R2/US)
(BARC-304) CFSTI: HC$3.00/MF$0.65

The effect of Na_2S and $Na_2S_2O_3$ on suppression of Ru volatility during glass fixation process was studied. It was found that by replacing Na_2O content of the glass mix with Na_2S, up to 99.9% Ru can be retained in the glass. Experiments on retention of volatilized Ru in ironoxide coated silicious bed material were conducted at bed temperatures of 500–800°C. Perchloric acid treatment of the bed material improved the retention efficiency of volatilized Ru in the order of 99.9%. Studies to form thermally stable compounds of Cs_2O with B_2O_3, TiO_2 and MoO_3 revealed that it was possible to supress Cs volatility appreciably with the above compounds. However, at higher temperatures of operation in the range of 1100°C with actual glass mix, little effect was noted. Author

N68-20980# Cornell Univ., Ithaca, N. Y.
ELECTRON DIFFRACTION STUDIES AT ELEVATED TEMPERATURES Final Technical Report
Simon H. Bauer Dec. 1967 38 p
(Contracts Nonr-401(41); ARPA SD-68; Grant NSF GP-4291; ARPA Order 23-63)
(AD-665316)

Contents: Construction and performance of a parallel incidence electron diffraction apparatus; Modifications of a microdensitometer for rotation of plates and digitized scanning; Reinvestigation of the structure of N2F4; The structures of several compounds as determined by electron diffraction are given. TAB

N68-21003# University of Southern Calif., Los Angeles.
AQUEOUS CHEMISTRY OF FREE RADICALS AND OTHER INORGANIC REACTIVE INTERMEDIATES Progress Report
Wayne K. Wilmarth [1967] 28 p refs
(Contract AT(11-1)-113)
(USC-113-P-4-9) CFSTI: HC$3.00/MF$0.65

Kinetic studies were made of the one-electron reduction of a superoxide complex of cobalt by OH^- in alkaline solution. Certain preparative reactions are also summarized. Preliminary attempts were made to assign the structures of the binuclear complexes on the basis of a comparison of their infrared and NMR spectra with those of the mononuclear compounds. Cyanide complexes of the lower oxidation states of Re are being studied. Analytical procedures for Re determination in these complexes are described. Attempts were made to prepare $Na_3Re(CN)_5OH_2$ and $K_5Re(CN)_6$. The chemistry of $Re(CN)_6^{-5}$ was studied. NSA

N68-21004# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
DIELECTRIC RELAXATION IN CHLOROFORM AND IN THE BINARY DIPOLAR MIXTURE. BENZONITRILE+ACETONITRILE
T. V. Gopalan, H. A. Boshers, and P. K. Kadaba 13 Dec. 1967 13 p refs
(Contract AT(40-1)-2840)
(ORO-2840-6) CFSTI: HC$3.00/MF$0.65

Mixtures of simple rigid polar molecules (acetonitrile and benzonitrile) were studied at microwave frequencies near room temperature. The dielectric relaxation of chloroform was also investigated. Results on the dipolar mixtures were analyzed in terms of two relaxation times τ_1 and τ_2 corresponding to the two polar components. There is good evidence to indicate that in the dielectric relaxation of mixtures studied, each species exhibits its own dispersion although it might be modified according to the concentration and nature of the second component. For chloroform in n-heptane the relaxation time tended in increase with increasing dilution. Data are presented in tables and graphs. NSA

N68-21005# Fordham Univ., New York. Dept. of Chemistry.
RELATED SPECTRAL AND STRUCTURAL STUDIES Progress Report
Philip S. Gentile 15 Dec. 1967 35 p refs
(Contract AT(30-1)-3675)
(NYO-3675-4) CFSTI: HC$3.00/MF$0.65

Progress is reported on the isolation of nine cis- or trans-bis(halogenoacetato) triethylenetetramine cobalt (III) complexes; the wealth of accompanying spectral data for comparison with

amine and ethylenediamine analogs that were previously isolated; the isolation of six pairs of the α and β isomers of trien Co(III) complexes; the isolation of dicyano and diisocyano trien Co(III) complexes; and the virtual completion of the structure of a trans-dicyano trien complex. Work with structural determinations, molecular orbital calculations, magnetic susceptibility, and solid–solid interactions is also reported. NSA

N68-21006# California Univ., Berkeley. Lawrence Radiation Lab.
MOLECULAR STRUCTURE OF STRONG ACIDS
Wayne E. Gargrave (M.S. Thesis) Dec. 1967 25 p refs
(Contract W-7405-ENG-48)
(UCRL-17915) CFSTI: HC $3.00/MF $0.65

The activities of perchloric acid and water were derived from available vapor pressure data. Various checks of the involved calculation were devised and used. Activities give information about the molecular structure and are indispensable in the interpretation of other data. Measurements of the rate of the reaction $H_2SO_4 + H_2O_2 = H_2SO_5 + H_2O$ confirmed the undissociated molecule H_2SO_4 as an intermediate. Thus rate determinations, in addition to Raman intensities and nuclear magnetic resonance, furnish a third method of exploring the molecular constitution of strong acids. Partial substitution of H by D did not change the rate. NSA

N68-21028# Stanford Research Inst., Menlo Park, Calif.
INVESTIGATION OF ANOMALOUS RADIATION-INDUCED ELECTRON PULSES IN ORGANIC LIQUIDS Final Report
S. I. Taimuty Dec. 1967 23 p refs
(Contract AT(04-3)-115)
(TID-24223) CFSTI: HC $3.00/MF $0.65

Anomalous radioinduced electron pulses produced by ^{60}Co gamma radiation and first observed in some purified liquid paraffins were studied. Several cells incorporating guard rings and parallel-plate or coaxial geometry were used. Liquid paraffins studied were n-hexane, n-octane, n-hexadecane, cyclohexane, and n-octacosane. Pulses were observed in only one sample of n-octacosane and in none of the other materials. The phenomenon could not be reliably reproduced in the n-octacosane samples, and attempts to establish unequivocally the nature of the phenomenon were unsuccessful. Author (NSA)

N68-21029# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
THERMODYNAMIC STUDIES ON HEAVY ELEMENTS AND STUDIES IN NUCLEAR CHEMISTRY Annual Report, Feb. 1967–Jan. 1968
J. W. Cobble, ed. 1 Jan. 1968 19 p refs
(Contract AT(11-1)-1716)
(COO-1716-4) CFSTI: HC $3.00/MF $0.65

Progress is reported in nuclear fission research (including ternary fission of ^{238}U induced by intermediate energy ^4He ions; ternary fission of ^{238}U induced by intermediate energy ^3He ions; ternary fission of ^{232}Th induced by intermediate energy ^4He ions; ternary fission studies on ^{209}Bi induced by intermediate energy ^4He ions; fission studies on iridium; excitation functions for the helium-ion induced fission of rhenium, lutetium, and thulium; and fission of rhenium by intermediate energy helium ions), general nuclear research (radiochemical searches for polymeric neutrons), and physical-inorganic research (thermodynamic function of Np(V) and Np(VI); heat of solutions of plutonium metal and the entropy of Pu(III); and the entropies of the trivalent lanthanide and actinide ions). NSA

N68-21039# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT CERTAIN POSSIBILITIES OF A MODEL OF RADIOACTIVE ANALYSIS OF ESPECIALLY CLEAN SUBSTANCES [O NEKOTORYKH VOZMOZHNOSTYAKH MODELI RADIOAKTIVATSIONNOGO ANALIZA OSOBO CHISTYKH VESHCHESTV]
I. A. Maslov and A. P. Obukhov 18 Aug. 1967 11 p refs Transl. into ENGLISH from Tr. i Vses. Koordinatsionngo Soveshch. po Aktivatsionnomu Analizu (USSR), 1964 p 28–32 Presented at the 1st All-Union Coord. Conf., 24–28 Oct. 1962
(FTD-HT-66-566; AD-665706)

The development of highly sensitive methods (10 to the -6th power to 10 to the -10th power %) of determining impurities by means of neutron activation encounters considerable difficulties in evaluating the sensitivity and accuracy of the analytical method employed. The authors therefore simulated the process of radioactivation analysis of high-purity substances. In their statistical treatment of the problem, the authors make use of the fact that the relative error of reproducibility of the analysis is independent of the purity of the sample and of the kind of element being determined. A physical model of radioactivation analysis was obtained for materials of high purity such as silicon, quartz glass, water, carbon, sulfur, etc., weakly activated by neutrons or producing mainly isotopes of gamma emitters after irradiation. Results of a study of direct gamma-spectroscopic activation analysis of high-purity silicon by means of the method of models are given. TAB

N68-21047 Purdue Univ., Lafayette, Ind.
THE SYNTHESIS OF SOME CYCLIC ORGANOSILICON COMPOUNDS
Robert Frederick Cunico (Ph.D. Thesis) 1966 222 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-5424

A synthetic route has been developed which allows the transformation of trichlorosilylalkenyl chlorides into good yields of pure 1,1-dichlorosila-2-cyclopentene and 1,1-dichlorosila-2-cyclohexene. The latter of these has been transformed further into the unique diene system 1,1-dichlorosila-2,4-cyclohexadiene. The attempted extension of this method to the synthesis of 1,1-dichlorosila-2-cycloheptene was successful. The synthesis of a number of medium-ring silacyclic compounds has been accomplished by cyclization of the appropriate dimethyldi(organo-functional)silanes. In this way were prepared 1,1-dimethyl-5-hydroxysila-4-cycloheptanone, 1,1-dimethylsila-5-cyclooctanone, and 1,1-dimethyl-6-hydroxysila-5-cyclononanone. Several of these were used in the preparation of 1,1-dimethylsila-4-cycloheptanone and 1,1-dimethylsila-5-cyclononanol. The addition of trichlorosilane to some model unsaturated compounds has been carried out under catalysis by dichlorobis-(ethylene)-μ,μ'-dichlorodiplatinum(II). Dissert. Abstr.

N68-21048# Stanford Univ., Calif.
DISTRIBUTION OF HYDROCARBON FLUIDS AND THEIR COMPOSITIONS IN VOLATILE OIL RESERVOIRS DURING DEPLETION
James Grover Taylor, (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4439

Described is a technique for mathematically simulating the solution-gas drive performance of a volatile oil reservoir on a digital computer. In the mathematical model, it is assumed that the phase behavior of the reservoir fluids may be approximated by a ternary hydrocarbon system and that the reservoir fluids are always in a state of thermodynamic equilibrium. The relationships between the overall concentration of the individual hydrocarbon components and the characteristics of the gas-oil relative permeability curves are shown quantitatively. Approximately ten minutes of computer time (Burroughs 5500) per run are required for the constant production-rate calculations reported. The reservoir studied was a linear system but extension to a radial system is outlined. The analysis developed may also be extended to hydrocarbon systems with more than three components. Dissert. Abstr.

N68-21053# Northeastern Univ., Boston, Mass.
PHOTOCHEMICAL STUDIES OF MOLECULAR SYSTEMS

In its Res. in Energy Conversion 30 Sep. 1966 p 166–490 refs (See N68-21051 11-03)

Reported are photochemical studies of molecular systems among which are included studies on apparatus for photochemical investigations; the photochemistry of perinaphthenone; the photochemistry of phenanthrenequinone; the unsensitized and sensitized photoreduction of disulfides; the photochemistry of 1,3,5-trinitrobenzene; charge transfer systems; laser photochemistry; and diphenylpicrylhydrazyl as a calibration standard in electron spin resonance spectroscopy. S.C.W.

N68-21054# Northeastern Univ., Boston, Mass.
INVESTIGATION OF NITROGEN-SULFUR SYSTEMS
R. N. Wiener, L. I. Rubin, and S. N. Singh *In its* Res. in Energy Conversion 30 Sep. 1966 p 491–588 refs (See N68-21051 11-03)

Tetrasulfurtetranitride and octatomic sulfur were examined spectroscopically, principally in the vacuum ultraviolet region of the spectrum. They were found to possess rather dissimilar spectra. The molecular exciton model was used in the interpretation of the data; delocalization of electrons was assumed to be relatively unimportant. In terms of the model employed, the differences in the spectra were to be anticipated. Energy level diagrams for both systems, as well as wave functions for the excited states, are presented. Intensities and transition frequencies were found in good agreement with the data. Although not investigated for the systems in this study, the polarization properties for the eigenstates were predicted by the exciton model. Disulfur dinitride was examined in the ordinary ultraviolet, and the vibrational fine structure of the $B_{2\mu} \leftarrow A_g$ transition was assigned based on progressions of two vibrational frequencies in the upper state. The thermodynamically determined N-S bond energy, in N_2S_2 is reported and is compared to the N-S bond energy in N_4S_4. Author

N68-21057# General Electric Co., Schenectady, N. Y. Electronic Physics Lab.
SOME APPLICATIONS OF AUGER ELECTRON EMISSION ANALYSIS TO STUDIES OF SURFACE SEGREGATION
L. A. Harris May 1967 11 p refs
(Rept.-67-C-199)

Surface segregation of chromium, antimony, and sulfur in steel, and of sulfur in nickel, was observed using an Auger electron method of analysis. The method provides a useful technique for studies of diffusion and segregation in solids. Author

N68-21058 California Univ., Davis.
A STUDY BY MEANS OF SECONDARY REACTIONS OF FRAGMENTS PRODUCED IN COPPER BY HIGH-ENERGY PROTONS AND ALPHA-PARTICLES
Karl Emil Dierenfeldt (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-5237

Copper targets were bombarded with 270- to 730-MeV protons and 330- to 880-MeV alpha-particles. Target thicknesses were varied for proton bombardments and 330-MeV alpha-particle bombardments. The secondary isotopes ^{69}Ge (produced by lithium fragments), ^{71}As, and ^{72}As (produced by beryllium fragments) were studied. For proton bombardments, the ^{69}Ge apparent cross sections rose rapidly with increasing proton energy. For alpha-particles they were essentially constant for all bombarding energies. The ^{71}As and ^{72}As apparent cross sections were constant for all proton energies, while for alpha-particle bombardment they were constant up to 600-MeV and increased slowly above this. In all cases, the apparent cross sections from alpha-particles were larger than those from proton bombardments. Dissert. Abstr.

N68-21068 Iowa State Univ. of Science and Technology, Ames.
CHROMATOGRAPHIC SEPARATIONS OF NIOBIUM TANTALUM, MOLYBDENUM, AND TUNGSTEN
Lionel Herbert Dahmer (Ph.D. Thesis) 1966 76 p
(Contract W-7405-ENG-82)
(IS-T-113) Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5577

Molybdenum, tungsten, niobium, and tantalum were quantitatively separated by cation exchange from many other metal ions. In the presence of excess peroxide in acidic solution, these four metal ions form anionic peroxy complexes which are not retained by cation exchange resin. Other metal ions which do not form such complexes are retained by the resin and are thus separated from the four title elements. A partition chromatographic method for separation of niobium, tantalum, molybdenum, and tungsten from each other was developed by adapting the hydrochloric acid, hydrofluoric acidmethyl isobutyl ketone system to a column. Batch distribution ratios were determined for the metal ions from various combinations of hydrochloric, hydrofluoric, and sulfuric acid into methyl isobutyl ketone. Quantitative separations of equimolar and variable amounts of the four metal ions were achieved. The relative standard deviation for 29 chemical analyses for molybdenum, tungsten, niobium, and tantalum was ±1.34%. Dissert. Abstr.

N68-21069 Louisiana State Univ., New Orleans.
STUDIES IN MOLECULAR SPECTROSCOPY. 1: ON THE MULTIPLICITIES OF PHOSPHORESCENT STATES OF ORGANIC MOLECULES. 2: POLARIZATION OF THE ABSORPTION OF $UO_2(NO_3)_2 \cdot 6H_2O$ SINGLE CRYSTAL. 3: THE ELECTRONIC STRUCTURE OF THE SULFUR/SULFUR BOND
Charles Michael O'Donnell (Ph.D. Thesis) 1966 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-1178

The value of the multiplicity g_u for use in the equation $k_p = 2\pi C\nu^2 n^2 (g_l/g_u) \int \epsilon d\nu$ is discussed and shown to lie in the range $1 \leq g_u \leq \infty$. The value best suited to most organic compounds at 77°K is shown to be $g_u = 3$. Polarized luminescence and luminescence excitation spectra for $UO_2(NO_3)_2 \cdot 6H_2O$ have been measured in both glassy solutions and in the single crystal at 77°K. Results were not definitive. Absorption polarization of the single crystal at 77°K indicates that there are at least three different electronic transitions in the interval 20583–27000 cm^{-1}. The nature of the sulfur–sulfur bond has long been a subject of controversy. To this end, the ultraviolet and NMR spectra were obtained for several simple disulfides, and semi-empirical molecular orbital calculations were performed. Dissert. Abstr.

N68-21080# California Univ., Berkeley. Lawrence Radiation Lab.
BEHAVIOR OF SOME TRANSITION METAL PORPHYRINS
Linda Kanner Phillips (Ph.D. Thesis) Dec. 1967 133 p refs
(Contract W-7405-ENG-48)
(UCRL-17853) CFSTI: HC $3.00/MF $0.65

In order to study the influence of porphyrin-type ligands on the chemistry of transition metal ions, the behavior of manganese in chelates with phthalocyanine, methyl pheophorbide-a, and etioporphyrin I was investigated. Oxidation and reduction reactions of the methyl pheophorbide-a and etioporphyrin complexes were studied both in solutions and in the solid state. The compounds are light sensitive: the chelated manganese (III) is reduced to manganese (II) under irradiation by white light. (Methyl pheophorbide-a) manganese(IV) was produced. Its reduction was studied to learn whether this reaction can serve as a model for the role of manganese in photosynthetic oxygen evolution. However, no formation of free oxygen was detected. Adducts with pyridine, acetic acid, water, and other vapors were studied using a quartz helix microbalance designed so that atmosphere and temperature could be controlled. Author (NSA)

N68-21081# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
MEASUREMENTS OF RATES OF ISOTOPIC EXCHANGE REACTIONS AT ELEVATED TEMPERATURES, AS STUDIED IN SHOCK TUBES
S. H. Bauer Dec. 1967 13 p refs
(Contract AT(30-1)-3211)
(NYO-3211-6) CFSTI: HC $3.00/MF $0.65

All single-pulse shock tubes were operated under improved control. More sophisticated computer programs became available for computing general equilibrium conditions behind incident and reflected shocks. Improvements were made in obtaining analytical data of shock-heated and rapidly quenched samples. The technique of "cleaning up" mixtures of various isotopic species of hydrogen without inducing scrambling was mastered. Experiments were run on mixtures of C_2H_2 with D_2, C_2H_2 with C_2D_2, and C_2H_4 with D_2. The mechanism that best accounts for results observed includes vibrational excitation of acetylene and subsequent formation of molecular dimers. Hydrogen exchange occurs through rearrangement during the dimer stage. For $C_2H_2+O_2$ the product dideutero compound was found to be approximately half that of the monosubstituted product while for $C_2H_4+D_2$ the amount of disubstituted product produced was very small, of the order of one-fifteenth that of the monosubstituted specie. Shock-tube data were obtained for homogeneous isotopic exchange between D_2 and H_2S, $^{32}O_2$ and $^{36}O_2$, and HD molecules. Studies were also made of vibrationally hot, translationally cold molecules. NSA

N68-21085# Bhabha Atomic Research Centre, Bombay (India).
FLASH PHOTOLYSIS UNIT FOR SPECTROSCOPIC STUDIES
N. S. Dalal and S. L. N. G. Krishnamachari 1967 18 p refs
(BARC-296) CFSTI: HC $3.00/MF $0.65

The 'Microsecond Flash Photolysis Apparatus' assembled here to study the absorption spectra of free radicals is described. The 'photolysis flash', fired by a condenser bank of capacity 25 to 150 μF at 7.5 KV maximum, lasts for 35 to 75 μ sec depending upon the capacity used and emits an intense radiation around 2500 A and a weaker continuum extending to higher wavelengths. The 'source flash' employs a condenser of 2 to 6 μ F capacity at 8 KV maximum, has durations of 15 to 35μ sec. according to the capacity used and emits an almost pure continuum extending from the quartz absorption limit (≈2000 Å) to about 10,000 Å. The intervals between the two flashes could be varied from about 10 μ sec. to 50 milli sec. or more. The auxiliary apparatus for photographic recording of absorption spectra is included. Performance of the set-up is illustrated by recording the absorption spectrum of the NH_2 radical. Further improvements on the present equipment are also indicated. Author

N68-21090# Sandia Corp., Albuquerque, N. Mex.
HIGH-TEMPERATURE METALLIC OXIDATION
H. S. Levine Sep. 1967 17 p refs Presented at the 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif.
(Contract AT(29-1)-789)
(SC-DC-67-1632; CONF-670935-7) CFSTI: HC $3.00/MF $0.65

The kinetics of oxide film growth on metals are postulated following Wagner's parabolic law. Facets discussed include reaction rates, oxide-gas boundary conditions, reactions in air and pure oxygen, relative oxygen demand, interstitial diffusion, and multi-phase systems. NSA

N68-21105 Maryland Univ., College Park.
REACTIVE SPECIES PRODUCED IN STYRENE AND POLYETHYLENE BY IONIZING RADIATION AND HYDROGEN ATOMS
Charalambos John Phalangas (Ph.D. Thesis) 1966 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-6145

For the purpose of a better understanding of the individual components of the radiation-induced styrene–polyethylene graft polymerization reaction, three problems were studied: (1) the radiation-induced polymerization of styrene at low temperatures, (2) radiation-induced ionic grafts on polyethylene, and (3) the effect of thermal hydrogen atoms on polyethylene. During the investigation of the first problem the effects of dose rate and temperature on the polymerization rate and molecular weight were studied. The second problem was attacked by testing the ability of isobutene and α-methylstyrene to form radiation-induced ionic graft on polyethylene fluff. In the investigation of the third problem an apparatus was designed and conditions established for the production of hydrogen atoms in the ground state. Their effects on polyethylene films and expanded polyethylene were studied. Dissert. Abstr.

N68-21113# General Electric Co., Schenectady, N. Y. Electronic Physics Lab.
ANALYSIS OF MATERIALS BY ELECTRON-EXCITED AUGER ELECTRONS
L. A. Harris May 1967 19 p refs
(Rept.-67-C-201)

The energy spectra of Auger electrons emitted from many elements and alloys have been observed. To obtain well-defined spectra it is necessary to suppress low-energy secondary electrons, to minimize noise, and to differentiate the secondary electron energy distribution curve with respect to energy. The Auger lines afford a sensitive indicator for light elements, although spectra for elements as heavy as gold have been obtained. Because the method examines only a superficial layer of the sample, it is useful for detecting contamination, surface migration or segregation and for diffusion studies. Cleaning of the surfaces is critical for useful analysis. Quantitative analysis is hindered by noise and the lack of known surface conditions for calibration. Author

N68-21119# Argonne National Lab., Ill.
CALCULATIONS ON THE KINETICS OF OXYGEN SOLUTION IN TANTALUM AND NIOBIUM IN A LIQUID-SODIUM ENVIRONMENT
T. F. Kassner and D. L. Smith Sep. 1967 22 p refs
(Contract W-31-109-ENG-38)
(ANL-7335) CFSTI: HC $3.00/MF $0.65

The parabolic rate constants for oxygen solution in tantalum and niobium in low-oxygen sodium were calculated as a function of temperature, oxygen concentration in sodium, and initial oxygen concentration in the refractory metals. The results were obtained at 500 to 800°C, oxygen concentrations in sodium from 1 to 20 ppM, and initial oxygen concentrations in the refractory metals from 0 to 0.10 at. % oxygen. The activation energy for the solution process was less than the activation energy for oxygen diffusion in the refractory metals. At low oxygen concentrations in sodium, plots of the logarithm of the parabolic rate constants versus reciprocal temperature were nonlinear for low initial oxygen concentrations in the refractory metals. Also, on the basis of phase equilibria calculations in the Ta–O–Na and Nb–O–Na systems, the conditions of temperature and oxygen concentration in sodium were predicted over which the phases tantalum and Ta_2O_5, and niobium, NbO, and NbO_2 are thermodynamically stable in sodium. NSA

N68-21128# Maryland Univ., College Park. Dept. of Chemistry.
STABLE ISOTOPE TRACER STUDIES Final Progress Report, 1 Jun.–15 Sep. 1967
Gilbert Gordon 22 Dec. 1967 6 p
(Contract AT(40-1)-2858)
(ORO-2858-19) CFSTI: HC $3.00/MF $0.65

Studies were concluded on the reaction between tris(1,10-phenanthroline)iron(II) and chlorate ions, chlorine dioxide, chlorite ion, hypochlorous acid, and chlorine in aqueous solution. Experiments carried out to show that complexes of 1,10-phenanthroline with iron can be used as a tool to discern whether oxidants under-go one- or multi-electron changes are described. NSA

N68-21137# Utah Univ., Salt Lake City. Inst. of Metals and Explosives Research.

RESIDUE ANALYSIS OF THERMALLY DECOMPOSED ISOCYANATOPENTAMMINE COBALT (III) PERCHLORATE

B. D. Chun and F. A. Olson 30 Sep. 1967 32 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.

(Contract AT(29-1)-789)

(SC-CR-67-2841) CFSTI: HC $3.00/MF $0.65

Analyses of (isothiocyanatopentammine)cobalt(III) perchlorate (ICCP) and solid ICCP decomposition products as a function of the stage of decomposition using X-ray, infrared, and wet chemical methods indicates several consecutive reactions. The principal intermediate solid species for decomposition in open air is NH_4ClO_4, with other minor intermediates being $Co(HCO_3)$, Co_4S_3, Co_3O_4, $CoCl_3$ $CoSO_4$ $HClO_4$ and NH_4Cl. The principal final residue is Co_3O_4. In a vacuum the decomposition mechanism differs from that in open air; some of the open-air decomposition steps apparently do not exist and initial ICCP is extant for a considerably greater fraction of the decomposition. However, it was found that the final decomposition product was mainly Co_3O_4 but NH_4ClO_4 was present to a greater extent as an end product. Based on these residue analyses and other studies fourteen possible equations of reactions are postulated. However, the principal reactions were initial ICCP decomposition with NH_3 gas as a principal product and decomposition of the intermediate NH_4ClO_4 to gaseous products. Author (NSA)

N68-21210# Los Alamos Scientific Lab., N. Mex.

A SEMI-THEORETICAL MODEL FOR CALCULATING THE ACTIVITIES OF NIOBIUM AND CARBON IN NIOBIUM MONOCARBIDE AS A FUNCTION OF COMPOSITION

Gerald L. de Poorter Oct. 1967 6 p refs

(Contract W-7405-ENG-36)

(LA-3744) CFSTI: HC $3.00/MF $0.65

Semi-theoretical equations were derived to represent the composition dependence of the niobium and carbon activities in niobium monocarbide. Empirical parameters are given for 1500 to 3000°K, typical results for the composition dependence of the activities are shown for 2500°K. Calculated results agree well with available measured quantities. Author (NSA)

N68-21222# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Chemie.

RADIO-CHEMICAL PRODUCTION OF TRACER COMPOUNDS. 1: INCORPORATION OF $^{14}CO_2$ IN ALCOHOL, CARBOLIC ACID, OXYGEN COMPOUNDS AND CARBONIC ACID [STRAHLENCHEMISCHE HERSTELLUNG MARKIERTER VERBINDUNGEN. 1: EINBAU VON $^{14}CO_2$ IN ALKOHOLE, PHENOLE, OXOVERBINDUNGEN UND CARBONSAEUREN]

F. Gutlbauer, N. Getoff, and K. Wess 1967 26 p refs In GERMAN Submitted for publication

(SGAE-CH-48/1967) CFSTI: HC $3.00/MF $0.65

Investigated was the radiochemical incorporation of C 14 in aqueous solution using aliphatic and aromatic hydroxyl compounds, aldehydes, ketones, and carbonic acids as model media. Preparation of the samples, irradiation and dosmetry, and chemical analyses are described. In general, acid mixtures resulted from the experiments. The individual acids, marked with the C 14, can be separated and obtained in pure form by means of thin layer chromatography, paper chromatography, ion exchange, extraction, or similar methods. The results are indicative of reaction type and possibilities concerning the organic radicals that were formed. Transl. by K.W.

N68-21240# Union Carbide Nuclear Co., Oak Ridge, Tenn.

DETERMINATION OF LITHIUM IN LITHIUM ALUMINATE

W. C. Dietrich 18 Jan. 1968 22 p refs

(Contract W-7405-ENG-26)

(Y-1601) CFSTI: HC $3.00/MF $0.65

A method was developed for determining the amount of lithium in the ceramic, lithium aluminate, and in other lithium compounds. Lithium is separated from any impurities by the cation exchange resin, Dowex 50-16X, and determined gravimetrically as the sulfate salt. The average recovery for lithium was 99.89% and the LE_x (0.95) was ±0.65%. An interim flame photometric procedure that was established prior to the development of the ion exchange-gravimetric method is also discussed. Author (NSA)

N68-21245 Illinois Univ., Urbana.

NICKEL (2) AND COBALT (2) COMPLEXES OF AMINE N-OXIDES AND ANILINE

David Webb Herlocker (Ph.D. Thesis) 1968 189 p

Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-6630

A number of pyridine N-oxide complexes of stoichiometry $[M(X\text{-}C_5H_4NO_nX_2]$ (M = Co(II), Ni(II), Cu(II); Z = 4-H, $-CH_3$, $-OCH_3$, $-OCCH_3$, $-NO_2$, $-Cl$; n = 4 or 6; X = ClO_4^-, BF_4^-) have been prepared and examined by infrared, electronic, and nuclear magnetic resonance spectroscopy. A number of trimethylamine N-oxide complexes of stoichiometries $[Co(TMNO)_4]X_2$ (TMNO = $(CH_3)_3N{\rightarrow}O$; X = ClO_4^-, BF_4^-, NO_3^-, Br^-, I^-, tosylate) and $[Co(TMNO)_2X_2]$ (X = Cl^-, Br^-, I^-, SCN^-) have also been prepared and studied by a number of physical methods. A number of cobalt(II) and nickel(II) complexes of aniline with stoichiometries $[M(C_6H_7N)_nX_2]$ (n = 2, 3, or 4; X = Cl^-, Br^-, I^-, SCN^-, NO_3^-, ClO_4^-, BF_4^-, acac) have also been prepared. Although the complexes have been definitely characterized in the solid state, in only a few cases was definitive characterization in solution possible. Dissert. Abstr.

N68-21263# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

TRACE METALS, EQUILIBRIUM AND KINETICS OF TRACE METAL COMPLEXES IN NATURAL MEDIA

Wayne Reimer Matson (Ph.D. Thesis) Jan. 1968 273 p refs

(Contract Nonr-1841(74))

(AD-666554)

A composite mercury graphite electrode (CMGE) was constructed and was shown to follow the theoretical behavior for thin film electrodes. An analytical system capable of performing multiple analysis of metal ions was built using the CMGE. Anodic stripping techniques using the CMGE were developed for obtaining information on the complicated distribution of the trace elements Zn, Cd, In, Pb, Cu, Bi, in samples from the environment, and for obtaining parameters related to the formation constant K, and the rate constants kf and kb for naturally occurring trace metal complexes of these metals and several others - Fe, Mg, Co, Ni, U. A portion of the trace metals atmospheric samples were found to be bound to particulate material of greater than one micron diameter. A ubiquitous nonlabile trace metal component was identified in all fresh waters. A quantitatively and qualitatively different nonlabile component is present in some sea water samples. Up to eight different nonlabile complexing agents were identified in one sample. Estuarine and surface mechanisms whereby nonlabile materials can be removed were studied briefly. A complicated distribution of strong labile complexes which is apparently associated with biological activity was also identified in many waters. TAB

N68-21285# Battelle-Northwest, Richland, Wash. Ceramics and Graphite Research Section.

STOICHIOMETRY EFFECTS IN OXIDE NUCLEAR FUELS. 1: POWER RATING REQUIRED FOR MELTING AND OXYGEN REDISTRIBUTION IN MOLTEN CENTER URANIUM OXIDE FUELS

J. A. Christensen Dec. 1967 107 p refs

(Contract AT(45-1)-1820)

(BNWL-536) CFSTI: HC $3.00/MF $0.65

Effects of departures from stoichiometry on heat transfer in $UO_{2\pm x}$ ($-0.10 \leq x \leq 0.15$) were measured by irradiation

experiments employing partially molten fuel specimens. Redistribution of excess oxygen or uranium was measured following irradiation. Author (NSA)

N68-21290# Bhabha Atomic Research Centre, Bombay (India).
SPECTROGRAPHIC ANALYSIS OF ANTIMONY SULPHIDE
T. S. Krishnan, Prem Kumar Dhall, and C. S. Sampath Kumar 1967 9 p ref
(BARC-311) CFSTI: HC $3.00/MF $0.65

A spectrographic method has been developed for the determination of As, Al, Bi, Ca, Cd, Cr, Fe, Mg, Mn, Pb and Zn from 0.05–1% and Si from 0.05–5% in Stibnite. The samples are mixed with barium fluoride and conducting graphite in the ratio 1 : 2 : 1 and are then excited in D.C. arc using shallow cup electrodes. Antimony itself is taken as internal standard and the percentage standard deviation lies within 10%. Author

N68-21296# Bureau of Mines, College Park, Md. Metallurgy Research Center.
OXIDATION OF LEAD BLAST FURNACE MATTE BY FERROBACILLUS FERROOXIDANS OR A DILUTE ACID SOLUTION
John D. Corrick and Joseph A. Sutton May 1968 24 p refs
(BM-RI-7126)

A dilute sulfuric-acid leach was developed for extracting lead and copper from lead blast furnace mattes and the chemistry was defined. The possible application of *Ferrobacillus ferrooxidans* to the problem of salvaging lead and copper from blast furnace mattes was also investigated. Operating conditions were varied to determine their effect on the oxidation and hence extraction of lead and copper from the matte. Conditions varied were temperature, pH, reaction time, aeration in the slurry, and particle size of the matte. A set of optimum conditions were developed that resulted in maximum lead and copper sulfide oxidation. Tests employing these optimum conditions resulted in 82.3 percent of the lead and 98.7 percent of the copper being extracted by a dilute acid leach, while maximum lead and copper extracted using *F. ferrooxidans* was 69.8 percent of the lead and 78.4 percent of the copper. Tests conducted with a different sample of blast furnace matte indicated that the dilute acid leach might have wide application in extracting lead and copper from other such blast furnace mattes. Author

N68-21304# Washington Univ., Seattle. Dept. of Chemistry.
COMPETITIVE UNIMOLECULAR DECOMPOSITION IN CHEMICALLY ACTIVATED RADICAL SYSTEMS. PROPYL RUPTURE
C. W. Larson, D. C. Tardy, and B. S. Rabinovitch [1967] 40 p refs
(Contract Nonr-77(36))
(TR-10A; AD-666548)

The study of the competitive unimolecular decomposition of chemically activated alkyl radicals is extended to cases of rupture of a propyl fragment versus a methyl or ethyl fragment. A study of the decomposition at room temperature of the octyl-4, heptyl-3 and 3-methyl-hexyl-2 radicals, formed by addition of H atoms to trans-octene-4, trans-heptene-3 and 3-methylhexene-1, is reported. The value of the dissociation energy for n-Pr-H is deduced to be within 0.8 kcal of the value of the dissociation energy for Et-H. Comparison of the results is made with values obtained on a theoretical model. Author (TAB)

N68-21308*# Alabama Univ. Research Inst., Huntsville.
ADVANCED ELECTROCHEMICAL TECHNOLOGY Semiannual Report, 1 Jul.–31 Dec. 1967
Edward W. Grohse and P. C. Chen 30 Jan. 1968 26 p refs
(Grant NGR-01-002-035)
(NASA-CR-94084; SAR-1) CFSTI: HC $3.00/MF $0.65 CSCL 07D

An advanced fuel cell of the gas diffusion type is being studied, including the development of improved mathematical representation of the predominant, performance-controlling phenomena occurring within the active pores of the electrodes of such cells. Fabrications and installation of experimental facilities for the advanced basic study of fuel cell and related electrochemical systems are under development; and preliminary studies are being made of a new flow-through concept in which continuous circulation of an emulsified electrolyte is used to overcome limitations of presently-used flow-through systems because of the low solubilities of hydrogen and oxygen in strong aqueous electrolytes at ordinary temperatures and moderate pressures. M.W.R.

N68-21332# Pictinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
THE COATING OF ALUMINUM WITH PLASTICS BY THE FLUIDIZED-BED AND ELECTROSTATIC POWDER TECHNIQUES
Arthur H. Landrock Feb. 1968 28 p refs Presented at the Aluminum Finishing Seminar, Detroit, 31 Jan. 1968
(PLASTEC-18; AD-666224)

The paper describes plastic powder coating of metal objects, particularly aluminum, by the fluidized-bed and electrostatic powder techniques. It points out the importance of control of process parameters such as preheat and postheat temperatures and dwell times, particle size and particle size distribution, and immersion time. Recent developments in coating powders are discussed. Also noted are the particular attributes of aluminum with regard to fusion powder coating. A number of typical applications are described, and the limitations of the fluidized-bed process are noted. Author (TAB)

N68-21334# Texas Technological Coll., Lubbock. Dept. of Chemistry.
ION RADICALS FROM ORGANIC SULFUR, SELENIUM TELLURIUM AND PHOSPHORUS COMPOUNDS Final Report, 1 Oct. 1965–30 Nov. 1967
H. J. Shine 1 Feb. 1968 11 p refs
(Grant AF-AFOSR-975-66)
(AFOSR-68-0392; AD-666042)

The report describes research in cation-radical formation, and on the reactions of cation radicals. The following are reported: the formation of cation radicals from substituted diphenyl sulfides in sulfuric acid and persulfuric acid; the complete esr spectrum of the thianthrene cation radical in aluminum chloride-nitromethane; the N-methylphenothiazine cation radical; and the reaction of thianthrene with iodine monochloride. Author (TAB)

N68-21344# Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.
STUDY OF POLYTYPIC PHASE RELATIONS AMONG COMPLEX INORGANIC STRUCTURES Semiannual Report, 1 May–31 Oct. 1967
Donald R. Peacor Jan. 1968 12 p refs
(Contract DA-28-043-AMC-01338(E))
(Rept.-5; Rept.-07325-5-T; ECOM-01338-5; AD-666201)

The structure of $2PbO.Fe_2O_3$, corresponding to the mineral hematophanite, and coexisting with plumboferrite in the $PbO-Fe_2O_3$ system, was determined to be a derivative of the perovskite structure. Relations with other structure types, e.g., diaboleite, cumengeite, pseudoboleite, boleite, and a ferroelectric mixed-layer series involving Bi_2O_2 and perovskite layers, are described. The superstructure of plumboferrite was redefined and its relation to magnetoplumbite clarified. Final results of the senaite structure determination are presented. Progress on the construction of a furnace for phase synthesis is reviewed. Author (TAB)

N68-21353# Bhabha Atomic Research Centre, Bombay (India).
THE USE OF VERMICULITE FINES IN CONJUNCTION WITH CHEMICAL TREATMENT FOR DECONTAMINATION OF RADIOACTIVE EFFLUENT
P. A. Bonhote, J. C. Jha, and K. T. Thomas 1967 15 p refs
(BARC-315) CFSTI: HC $3.00/MF $0.65

Low level radioactive effluent may be decontaminated by a two stage process utilizing chemical flocculation and ion exchange on vermiculite. Vermiculite was used to date either in columns or in a basket centrifuge. In this report the possibility of combining the two stages is examined. The results of a series of laboratory experiments to evaluate the effects of particle size, contact time, sequence of addition and different chemical treatments are reported. It is considered that fine vermiculite may be added to the chemical flocculation process, thus eliminating the need for columns or a centrifuge, and reducing the cost of treatment. Author

N68-21364# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Physics.

IONIZATION, FRAGMENTATION AND ION-MOLECULE REACTIONS OF NH_3 AFTER ION IMPACT

G. Sahlstroem and I. Szabo 31 Aug. 1967 61 p refs
(Contract AF 61(052)-762)
(AFCRL-68-0075; SR-9; AD-666027)

Mass spectra of ammonia (NH3) were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. Two regions with very low probability for ionization exist between 12.5 and 15 eV and around 21 eV. Integration of the breakdown graph gives a mass spectrum in agreement with that obtained in electron impact. The ion-molecule reactions were studied using the pressure dependence of the ion-currents in the pressure range mm Hg. The order and mechanisms of the formation of the product ions are determined at different energies absorbed by the molecule during the charge exchange. The structure and dissociation of ammonia are discussed. Author (TAB)

N68-21378# California State Coll., Los Angeles. Dept. of Chemistry.

FURTHER STUDIES ON THE PHOTOLYSIS OF 2,3-DICARBA-HEXABORANE

James E. Scott, Jr., and J. R. Spialman 15 Feb. 1968 44 p refs
(Contract Nonr-3364(00))
(TR-17; AD-666314)

The gas phase photochemical formation of 1,5-C2B3H5, 1,2-C2B4H6, and 1,6-C2B4H6 from C2B4H8 was investigated. Light energy at about 2200A is absorbed directly by the carborane, rather than by way of photosensitization by mercury atoms. Photolysis in the presence of added gases such as O2 and C2H4 gives essentially the same yield and distribution of products implying that free radicals and BH3 are not involved in the product formation. The ultraviolet spectra of B5H11, B6H10, CH3CB5H8, C2B4H8, and (CH3)2C2B4H6 were recorded and compared. Some of the physical properties of 1,2-C2B4H6 were measured and summarized. The vapor pressure measurements indicate that the normal boiling point is 39.1C and the observed melting point is -25.4 to -24.4C. Author (TAB)

N68-21404# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF THE PREPARATION OF DEUTERIUM CONTAINING PALLADIUM AND TITANIUM TARGETS FOR NEUTRON GENERATION [ETUDE DE LA PREPARATION DE CIBLES DE PALLADIUM ET DE TITANE CHARGEES EN DEUTERIUM POUR LA GENERATION DE NEUTRONS]

Habib Latrous 1967 54 p refs In FRENCH
(CEA-R-3065)

After briefly reviewing the use and production problems of tritiated and deuteriated targets, the following topics are treated: 1) Charging of palladium and titanium wires; 2) Contribution to structural studies concerning palladium and titanium deuterides; and 3) Charging of targets and neutron production tests. The conclusion stresses the fact that electrochemical charging is not of very great interest for the preparation of deuterated or tritiated targets, but makes it possible nevertheless to study effectively the structure of the deuterides. Author (NSA)

N68-21422# Bhabha Atomic Research Centre, Bombay (India).

STRUCTURAL CONSIDERATIONS IN SURFACE REACTIONS WITH URANIUM OXIDES

M. D. Karkhanavala 1967 20 p refs
(BARC-307) CFSTI: HC $3.00/MF $0.65

Gas-solid reactions involving uranium oxides are discussed according to whether the uranium oxide acts as the solid substrate or the gaseous molecule. The reactions taking place on a urania or uania based catalyst surface are illustrative of reactions of the first type, in which it is shown that the variable valency and the consequent changes in ionic radius of the uranium ions is of considerable importance. The possible gas-solid reactions taking place on a solid uranium oxide (UO_2) surface exposed to an environment containing oxygen are postulated and discussed from considerations of crystal chemistry. The important role of point group symmetries of the gaseous molecule and of the substrate surface, in determining the course of gas-solid surface reactions of the second type is elucidated and illustrated from reactions of gaseous UO_3 with different solids (oxides). The extension of this principle to other gas-solid reactions is suggested. Author

N68-21426# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

VAPOR PRESSURES OF LIQUID COLUMBIUM (2740° TO 3140°K) AND LIQUID HAFNIUM (2500° TO 2810°K)

R. K. Koch, W. E. Anable, and R. A. Beall May 1968 29 p refs
(BM-RI-7125)

The vapor pressures of liquid columbium and liquid hafnium were determined by the Langmuir free evaporation method as a part of the Bureau of Mines program on the study of transition metals. An electron-beam furnace with a water-cooled copper crucible was used for melting. Temperature was measured with a two-color ratio pyrometer. Third-law evaluations of each data set gave mean heats of sublimation (298.15°K) of 175.1±3.2 kcal/mole and 148.3±1.2 kcal/mole for columbium and hafnium, respectively. Second-law standard heats of sublimation determined from sigma plots and from sigma-prime plots agreed fairly well with the third-law values. The sigma-prime plots gave standard entropies of sublimation of 30.96±0.84 eu and 33.56±0.44 eu for columbium and hafnium, respectively. Author

N68-21430*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

METHOD AND RESULTS OF STUDYING VAPOR DEPOSITION NUCLEATION PROCESSES BY IN SITU ELECTRON MICROSCOPY

Helmut Poppa Washington Apr. 1968 30 p refs
(NASA-TN-D-4506) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The kinetics of nucleation in some simple substrate-overgrowth systems have been measured quantitatively by improved in situ electron microscopy techniques. The nucleation of bismuth and silver on evaporated carbon and the nucleation of bismuth on evaporated SiO substrates were studied as a function of substrate temperature and impinging flux. The results were analyzed in terms of the phenomenological theory of nucleation and in terms of Walton's atomistic model of condensation from the vapor phase. Both theoretical concepts led to specific conclusions concerning such nucleation parameters as the number of atoms in the critical nucleus n^* and the free energy of desorption ΔG_{des}. The substrate temperature and impingement flux dependence of the maximum number of particles deposited on the substrate surface were determined and tentatively interpreted on the basis of nucleation limited surface migration. Some nucleation induction time observations were made and were related to the clustering kinetics

of adatoms, the growth process of individual nuclei, and the instrument limitations of the detection method. Author

N68-21457# United Kingdom Atomic Energy Authority, Harwell (England).

CONSIDERATIONS IN SELECTING A METHOD FOR DETERMINING TRACE CONSTITUENTS

H. Schueller Jun. 1967 10 p ref Transl. into ENGLISH from Mikrochim. Acta (Vienna), no. 4/5, 1966 p 742–750 Presented at Symp. on Anal. Chem., Graz, 29 Sep.–1 Oct. 1965

(LB/G-2584; CONF-650992-1) CFSTI: HC$3.00/MF$0.65

In the determination of substances that are present in very small amounts it is primarily necessary to find the errors of the individual steps in the analysis. The greatest partial error governs the total error of the method and is usually due to the heterogeneity of the material being examined. Only with a knowledge of the total error can a decision be reached as to whether the analysis has informational value and what apparatus is necessary. The concepts error, precision, and accuracy are defined and examples are considered. Author (NSA)

N68-21463# Bureau of Mines, Reno, Nev. Metallurgy Research Center.

RECOVERY OF CERIUM AND LANTHANUM BY OZONATION OF LANTHANIDE SOLUTIONS

D. J. Bauer and R. E. Lindstrom May 1968 14 p refs

(BM-RI-7123)

The procedures, materials, and apparatus for effectively recovering cerium and lanthanum from complex rare-earth mixtures in solution is described. The procedure involves the ozone oxidation of cerium ion in aqueous solution and the simultaneous precipitation of a purified cerium product. The oxidation-precipitation reaction was investigated as a means of coprecipitating rare-earth elements heavier than cerium with the cerium to provide an upgraded lanthanum fraction in the filtrate. The recovery and purity of CeO_2 and La_2O_3 as a function of pH and time at ambient temperature and 85°C is also discussed. B.S.D.

N68-21492# Bonn Univ. (West Germany).

THE PHOTODECOMPOSITION OF CARBON MONOXIDE IN THE FAR ULTRAVIOLET

Hans-Juergen Rommel 1967 24 p refs

(Contract AF 61(052)-381)

(AD-664934)

The photodecomposition of CO molecules by irradiation with the Kr and Xe resonance wave lengths leads to very small quantum yields of CO2 and C3O2. The CO2 quantum efficiency lies between the limits 0.0064 and 0.039 for the Kr radiation, between 0.0055 and 0.0091 for the Xe radiation. These values are due to the absorption of both resonance lines in each case. The experiments lead to the following quantum yield ratios (mean values): QCO2/QC3O2 = 2.6 for lambda = 1165A and lambda = 1236A; and QCO2/QC3O2 = 1.5 for lambda = 1295A and lambda = 1470A. Because of the reactivity of carbonsuboxide a certain amount reacts with H2O at the walls or polymerises before being measured. TAB

N68-21494# Bonn Univ. (West Germany).

PHOTOCHEMICAL DISSOCIATION OF NITROGEN MOLECULES

Winfried Pessara 1967 29 p refs

(Contract AF 61(052)-381)

(AD-664933)

A krypton sensitized mixture of the two stable molecules 14N2 and 15N2 was irradiated with the two krypton resonance wave lengths Lambda-1 = 1165A and Lambda-2 = 1236A. The experiments showed that an amount of the mixed molecule 14N15N was formed increasing with illumination time. It was concluded that the photochemical dissociation of nitrogen molecules is possible, and that the dissociation energy is smaller than the shorter wave length Lambda-1 corresponding to 10.64 ev. The possibility that the mixed molecules were formed by collision of excited molecules cannot be excluded. Results of the experiments with the nitrogen isotopes are used to explain why the mass spectrometric detection of N2H4 was unsuccessful. TAB

N68-21498# Ballistic Research Labs., Aberdeen Proving Ground, Md.

DETERMINATION OF PRINCIPAL REACTIONS IN 4:1 MIXTURES OF N_2 AND O_2 DURING CONTINUOUS IONIZATION

Franklin E. Niles Nov. 1967 134 p refs

(BRL-R-1388; AD-666214)

Computer solutions were obtained for 15 simultaneous differential equations which describe the time rate of change of electrons, NO2(-), O(-), O2(-), O3(-), N2(+), O(+), O2(+), NO(+), N, NO, N2O, NO2, O and O3 during continuous ionization. Initially 139 reactions involving these 15 species plus N2 and O2 were considered using the computer code. The number of reactions was reduced to 35 without appreciably changing the solutions. Further reduction to 15 reactions gave orders of magnitude changes in the solutions. Reinsertion of three mutual neutralization reactions involving NO(+) gave solutions close to those obtained employing 35 reactions. The solutions reveal that the NO(+) and NO2(-) number densities become the largest of the positive ions and negative ions, respectively. The reaction sequences which lead to this result were determined. These sequences along with the neutral formation sequence are represented by schematic diagrams. Author (TAB)

N68-21500# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.

THERMAL DESORPTION OF CARBON MONOXIDE FROM NICKEL

Alan W. Smith Feb. 1968 58 p refs

(D1-82-0707; AD-666596)

The adsorption of carbon monoxide on nickel has been studied by the thermal desorption technique. Thermal desorption peaks for states with activation energies of desorption of 13, 27, and 39 Kcal/mole have been identified. Other weakly adsorbing states were present but the peaks could not be resolved. Preparing the surface by oxidation and reduction and by argon ion bombardment gave thermal desorption curves similar in peak temperatures but not in peak heights. Two effects were noted with the runs where water pressure was appreciable in the system. It was necessary to heat the samples in carbon monoxide to obtain adsorption into the highest energy states and also carbon dioxide was observed with this carbon monoxide peak. These effects were attributed to the oxidation of the surface by the water vapor. It was also necessary to treat the sample strongly to remove carbon near the surface to obtain a stable clean surface. Annealing the ion bombarded surface increased the number of high energy (39Kcal) sites and decreased the number of moderate energy (27 Kcal) sites. The logarithm of the frequency factor was found to be a linear function of the square root of the activation energy for desorption. The presence of hydrogen when carbon monoxide is adsorbed at elevated temperatures gives rise to a new desorption peak between 600K and 700K. Author (TAB)

N68-21504# Monsanto Research Corp., Dayton, Ohio.

SOLVENT EXTRACTION STUDY OF METAL FLUOROACETYLACETONATES Scientific Interim Report, 10 Sep. 1966–9 Sep. 1967

William G. Scribner Wright-Patterson AFB, Ohio ARL Nov. 1967 103 p refs

(Contract AF 33(615)-1093)

(ARL-67-0205; AD-666459)

Solvent extraction studies employing benzene or chloroform solutions of 1,1,1,5,5,5-hexafluoro-2,4-pentanedione (H(hfa)),

1,1,1,2,2,6,6,6-octafluoro-3,5-hexanedione (H(ofhd)) 1,1,1,2,2,3,3,7,7,7-decafluoro-4,6-heptanedione (H(dfhd)), and 1,1,2,2,3,3-heptafluoro-7,7-diemthyl-4,6-octanedione (H(fod)) are described. Enhancement of extraction efficiency via adduct formation with isobutylamine (IBA) is also described for most systems. Log distribution ratio-pH data and equilibration time studies are presented for the extraction of zinc, cobalt(II), nickel, and cadmium with chloroform-H(hfa)-IBA; for the extraction of zinc and cobalt(II) with chloroform-H(ofhd) and with chloroform-H(ofhd)-IBA; for the extraction of zinc and cobalt(II) with chloroform-H(dfhd) and with chloroform-H(dfhd)-IBA; and for the extraction of zinc, cobalt(II), cobalt(III), and iron(III) with benzene-H(fod). The extraction of trace beryllium with benzene containing copper trifluoroacetylacetonate via an exchange reaction is discussed and the effect of beryllium concentration and copper trifluoroacetylacetonate concentration is noted. The synthesis and purification of H(ofhd) and H(dfhd) are described in detail, and NMR data, infrared spectra, density, and refractive index measurements of these beta-diketones are reported.
Author (TAB)

N68-21521# Bonn Univ. (West Germany).
FLASH PHOTOLYSES OF NH_3 IN THE VACUUM ULTRAVIOLET
K. D. Bayes, K. H. Becker, and K. H. Welge 1967 13 p
(Contract AF 61(052)-381)
(AD-664932)

The decomposition of NH3 in the gas phase was investigated in the vacuum ultraviolet by flash photolysis. Quartz windows were used as filters until 2.000A and 1.600A respectively, CaF2 windows until 1.250A. It could be shown that photochemical primary processes can be examined qualitatively in a windowless device. For this purpose a flash light source with sufficient short-time light impulse is necessary to prevent disturbances from the discharge by a large distance between the discharge and the reaction chamber. Disturbances occurred in the reaction chamber - probably as pressure waves - after more than 20 microsec. In accordance with earlier experiments the NH2 radical was found at wavelengths above 2.000A, whereas below 1.600A in addition to it the NH radical was detected as primary product. Around 10% of the NH radicals were formed in the ground state with one vibration quantum (v = 1). In windowless illuminations and at relatively low pressures the Balmer series of the H atom was found in absorption.
Author (TAB)

N68-21547# Electric Storage Battery Co., Yardley, Pa. Research Center.
HIGH ENERGY SYSTEM (ORGANIC ELECTROLYTE) Semiannual Report, 15 Jun.–15 Dec. 1967
D. P. Boden, H. R. Buhner, and V. J. Spera Ft. Monmouth, N. J. Army Electron. Command Feb. 1968 79 p refs
(Contract DAAB07-67-C-0385)
(ECOM-0385-1; AD-666230)

The results of previous studies of the Li/CuF2 couple indicated that the major problems remaining to be solved were in improving the activated storage and discharge rate capabilities. The major efforts in the present investigations concerned with attempts to alleviate the above-mentioned problems. In the case of activated storage limitations, it was thought that certain impurities in the electrolyte components might promote dissolution of CuF2. Both LiClO4 and propylene carbonate were submitted to extensive purification procedures. In addition, LiClO4 was specially treated to remove traces of water. New solvents and solvent mixtures were evaluated in an effort to develop an improved electrolyte. New conductive additives were evaluated in order to determine their effect on the discharge efficiency and activated storage capability of the CuF2 cell was evaluated under both vacuum and dry argon storage conditions. A voltammetric technique, using a mercury pool cell was employed to determine the constitution of the soluble copper species in organic electrolyte.
TAB

N68-21565# Little (Arthur D.), Inc., Cambridge, Mass.
THE STRUCTURE OF LIQUID WATER
R. A. Horne 15 Mar. 1968 30 p refs To be presented at the 7th Intern. Conf. on the Properties of Steam, Tokyo, Sep. 1968
(Contract Nonr-4424(00))
(TR-33; AD-666579)

Modern theories of water structure fall into two general categories--mixture models and continuum models. The Frank-Wen model envisions liquid water as consisting of a mixture of flickering clusters of H-bonded water molecules and more or less free monomeric water. As the temperature increases the clusters melt and the fraction of H-bonded molecules in the liquid gradually decreases, although this fraction is till appreciable even at the boiling point. The clusters are less dense than the free water and as a consequence the application of hydrostatic pressure is very effective at destroying the regions of bound water. The addition of electrolytes may make or break the local water structure while the addition of nonpolar solutes or an interface tends to enhance the adjacent water structure. Two different types of hydration envelope are distinguished: temperature and pressure stable, dense, hydrophobic hydration surrounding nonpolar solutes, hydrophobic molecules and hydrophobic segments of biopolymers, and gas-water and solid-water interfaces and coulombic hydration surrounding ions and charge sites. The coulombic hydration atmosphere is itself complex consisting of at least two zones--an inner zone of dense, tightly held electrostricted water and an outer, less dense zone which appears to be indistinguishable from a Frank-Wen cluster.
Author (TAB)

N68-21605# Kansas State Univ., Manhattan.
INFRARED ABSORPTANCE OF CO AND N_2O AT REDUCED TEMPERATURES
Gary M. Hoover 15 Dec. 1967 208 p refs
(Contract AF 19(628)-4315)
(SR-1; AFCRL-68-0007; AD-666069)

Two separate investigations are described. The first involves the measurement of the equivalent widths of lines R(0) to R(15) in the fundamental band of CO at temperatures of 300, 193, 153, and 113 degrees Kelvin. On the basis of the data obtained line strengths and half-widths of self-broadened lines have been determined for each temperature. The line strengths agree with the predictions of Herman and Wallis. At 153 and 113 degrees Kelvin the measured half-widths disagree with predictions based on room-temperature data and on simple kinetic-theory considerations. The second investigation is concerned with total band absorptance of CO and N2O in the temperature range 363 to 198 degrees Kelvin. The results can be used in testing band-model calculations.
Author (TAB)

N68-21640# Rocketdyne, Canoga Park, Calif.
A BENT BOND MODEL FOR THE VIBRATIONAL FORCE CONSTANTS OF NON-PLANAR XY_3 MOLECULES
E. C. Curtis Washington AFOSR Feb. 1968 21 p refs
(Contracts AF 49(638)-1135; AF 49(638)-1734)
(R-7386; AFOSR-68-0155; AD-666456)

A model is developed for the vibrational force constants of non-planar XY_3 molecules which includes terms for bent bonds. The stretching and non-bonded atom repulsion terms are the usual Urey–Bradley type while the bending force constant is replaced by a force constant for the angle between the bond forming orbitals and a term for the amount by which the bond is bent. These force constants are then transformed into the usual internal coordinates. For the molecule NF_3 which has large forces between the non-bonded atoms, the computed vibrational force constants are consistent with the bent bond model assuming the bonds are bent by some 5° although it is not possible to solve uniquely for all the adjustable parameters. Orbital following effects do not suffice for NF_3 so there is some plausibility for this model. For some XH_3 molecules, whose force constants can be accounted for by orbital

following effects and where non-bonded atom forces are small, there is no evidence for bent bonds, in accord with most chemists' intuition. Author

N68-21645# Dayton Univ., Ohio.
QUANTITATIVE STUDY OF SOME ORGANIC COMPOUNDS BY X-RAY DIFFRACTION Technical Report, Sep.–Nov. 1967
Mark A. Goldschmidt Wright-Patterson AFB, Ohio AF Mater. Lab. Jan. 1968 27 p refs
(AFML-TR-67-403; AD-666463)

A fast and reliable method is described for the quantitative analysis of some organic compounds by X-ray diffraction. The method partially eliminates some of the variables restricting the use of X-ray diffraction in a study of this nature. A specimen holder is described which permits the sample to spin during the analysis. The use of an internal standard greatly increased the reproducibility attained in this report. No instrumental corrections were applied to the data obtained. Author (TAB)

N68-21666# Michigan Univ., Ann Arbor. Fluid Dynamics Lab.
GAS CHROMATOGRAPHIC SEPARATION OF CARBONYL FLUORIDE AND CARBON DIOXIDE
George A. Drennan and Richard A. Matula Dec. 1967 12 p refs
(Grant AF-AFOSR-1144-66)
(Publ.-67-2; AFOSR-68-0461; AD-666458)

An experimental method for the quantitative analysis of both CO2 and CF2O in gas mixtures is described. The analysis is based on thermal conductivity gas chromatography techniques, and it is shown that the detector response is linear over a wide range of CF2O concentrations. Author (TAB)

N68-21693 California Univ., San Diego.
NUCLEAR MAGNETIC RESONANCE STUDIES IN THE NORMAL AND SUPERCONDUCTING STATES OF SOME V_3X COMPOUNDS
Bernard George Silbernagel (Ph.D. Thesis) 1966 249 p
Available from Univ. Microfilms: HC $11.25/MF $3.25 Order No. 67-6388

The properties of a series of intermetallic compounds with the β-W crystal structure and the chemical composition V_3X (where X=Si, Ga, Ge, Pt, Ir) have been investigated. Pulse NMR measurements have been made on the powder samples to determine spin–spin relaxation time and the spin-lattice relaxation time of the V^{51} nuclei as a function of resonance parameters and temperature from 500°K to 1.35°K. Steady state NMR measurements have been made on the single crystals of V_3Si to determine the line positions, the line widths, the strength of the nuclear quadrupole coupling and the Knight shift of the resonance as a function of the resonance parameters, the sample orientation and temperature. Author

N68-21701# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
PROCEDURE MANUAL FOR THE DEPARTMENT OF ELECTRON MICROSCOPY. 3: STAINING OF SECTIONS. CHEMICAL TREATMENT OF SECTIONS [RICETTARIO AD USO DEL REPARTO DI MICROSCOPIA ELETTRONICA. 3: METODI DI CONTRASTO SU SEZIONI. TRATTAMENTI CHIMICI DI PREPARATI]
9 Sep. 1967 56 p refs In ITALIAN; ENGLISH summary
(ISS-67/26) CFSTI: HC $3.00/MF $0.65

This is the third of five reports in which chemical, physical and biological procedures employed in the department of electron microscopy are collected. In the first part of this issue, the staining techniques experienced in the department are described, both on ultrathin sections to be observed in the electron microscope, and on thick sections for conventional microscopy (staining methods, fluorescence contrast, and phase contrast). Author

N68-21711# Technische Hogeschool, Eindhoven (Netherlands).
LIGAND HYPERFINE STRUCTURE IN THE ESR SPECTRA OF THE IONS $MoOF_5$ AND $CrOF_5$
Johannes Leonardus Verbeek (Ph.D. Thesis) 1968 80 p refs

The work described in this thesis consists of two closely related parts, the first being an attempt to interpret the ligand hyperfine structure in ions of the general type MOX_5^{2-}, with M a transition metal ion, and X a halogen; this is done by means of a simple but pictorial model. The second part contains a brief review of recent opinions on the nature of the electronic structure of those complexes. A model of ligand-electron-interaction is proposed, using a simple dipole–dipole-interaction mechanism; and the peculiarities of the ESR spectra of such samples are discussed. Experimental data are also presented, and an interpretation is given. A check of this interpretation lies in the comparison of X- and Q-band spectra, and in the use of isotopes of the metals. Within the restrictions imposed by the lack of experiments with single crystals, the given interpretation is satisfactory. In an attempt to decide between diverging opinions in the literature, semi-empirical calculations of the electronic structure of the present ions were made. Results of these calculations appeared inadequate to make positive statements as to the correctness of any of the opinions put forward by various authors. Some propositions from the literature are presented in some detail, and it is concluded that a reliable ab-initio calculation, for instance of the unrestricted Hartree–Fock type, may be the only plausible approach. Author

N68-21723 Oklahoma Univ., Norman
A THEORY OF ELECTROLYTE SOLUTIONS
John Halbert Tucker (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3983

Electrolyte solutions of moderate concentrations are described by a model depicting the solution as being composed of individual chemical formula units at any instant in time. The ions of each unit can range over a spatial domain determined by customary statistical criteria; the average unit volume is given by V/N. Application of the Lagrangian method with system constraints of constant number, energy and volume leads to a modified form of the Maxwell–Bolzmann equation. The interactions considered are restricted to the coulomb interactions between the pairs of oppositely charged ions comprising a unit. Assuming that these interactions are responsible for the non-ideality of a solution, the unit configuration integral can be related to the activity coefficient of the solute. The limiting theoretical behavior of the solution properties is a function of the cube root of the molar concentration. The tendency for activity coefficient curves to bend upward at high concentrations is explained in terms of a van der Waals covolume effect. Dissert. Abstr.

N68-21734# Royal Inst. of Tech., Stockholm (Sweden). Physics Dept.
ON THE FIRST EXCITED STATE OF NO^+
H. Sjoegren and I. Szabo 31 Aug. 1967 16 p refs
(Contract AF 61(052)-762)
(AFCRL-68-0074; SR-10; AD-666028)

The ionization potential of the first excited state of NO(+) was investigated using charge exchange in a double mass spectrometer of perpendicular type. The charge exchange cross section and the recombination energy determinations show good agreement with photoelectron and penning ionization electron spectroscopy values demonstrating again the compatibilities of the results from these methods and the method of charge exchange in a perpendicular-type mass spectrometer. The recombination energy determinations also show that the first excited state of NO(+) is a triplet state. Author (TAB)

N68-21737# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Physics.
CHARGE EXCHANGE PROCESSES Final Scientific Report, 1 May 1964–31 Jul. 1967

Einar Lindholm 31 Aug. 1967 7 p ref
(Contract AF 61(052)-762)
(AFCRL-68-0076; AD-666029)

Charge exchange and ion-molecule reactions have been studied of the following compounds: CH3NH2, C2H4, CH4, CH3Cl, CH3I, O2, CO2, H2O, CH3OH, NH3, NO. Other recent work is reviewed. Author (TAB)

N68-21746# Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (West Germany).
INTERNATIONAL CONFERENCE ON PHOTOCHEMISTRY, PART 2
Sep. 1967 326 p refs Conf. held at Munich, 6–9 Sep. 1967
(PB-176467) CFSTI: HC $3.00/MF $0.65

Preprints are presented in the areas of: intermediates in photochemical reactions, reactions of optically excited species, and fluorescence and phosphorescence. The first section includes papers on the reactivity of carbon dioxide, the photochemical rearrangement of benzene, quenching of photochemical reactions between aromatic compounds and acyclic conjugated dienes, primary photochemical processes in simple aromatic molecules, relaxation methods for measuring radiationless transition rates, radical intermediates formed in photolytic dehydrogenation of acridans, the photochemical decomposition of diphenyldiazomethane in the absence of a solvent, and ultraviolet photolysis of the triphenylmethyl–halide ion pairs. Papers on the effect of mercury on the triplet state of hexafluoroacetone, mercury photosensitized decomposition of methyl ethyl ether, and mechanistic diagnosis and energy transfer studies by benzene photosensitization of cyclic ketones and olefines are included in the second section. The fluorescence and phosphorescence section includes organic dye lasers, wide angle interference and multipole nature of fluorescence and phosphorescence of organic dyes, luminescence of sterically hindered arylethylenes, and thermoluminescence following photoionization in rigid media. E.J.S.

N68-21750# Tennessee Univ., Knoxville.
SEPARATION OF OPTICAL ISOMERS BY SOLVENT EXTRACTION Final Report
George K. Schweitzer and Newell S. Bowman Jan. 1968 60 p refs
(Grant DA-ARO(D)-31-124-G577)
(AROD-3909-3-C; AD-665434)

Techniques were developed which effect the partial resolution of organic racemates and of optically active neutral chelates by solvent extraction. Theoretical considerations and experimental results are given. TAB

N68-21782 North Carolina Univ., Chapel Hill.
NUCLEAR MAGNETIC RESONANCE STUDIES INVOLVING INTERMOLECULAR AND INTRAMOLECULAR EXCHANGE, PARTS 1
Robert James Day (Ph.D. Thesis) 1966 171 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-5333

The labilities of individual metal-ligand bonds, as determined quantitatively from proton magnetic resonance spectra, are discussed and interpreted for a series of complexes of some diamagnetic metal ions with (ethylenedinitrilo)-tetraacetic acid (EDTA), meso-(2,3-butylenedinitrilo)tetraacetic acid (BDTA) and trans-(1,2-cyclohexylenedinitrilo)tetraacetic acid (CyDTA). The EDTA complexes of most of the common divalent metal ions have relatively short metal-nitrogen bond lifetimes compared to the corresponding complexes with BDTA and CyDTA. The differences in lability are ascribed to structural effects within the ligand. Rate constants for deuterium transfer in D_2O solutions of trimethylammonium ion at 33°C have been measured by proton magnetic resonance from the collapse of proton-deuterium coupling. Dissert. Abstr.

N68-21838 Ohio State Univ., Columbus.
HETEROGENEOUS NUCLEATION IN VAPOR-SOLID TRANSFORMATIONS
Curtis Maitland Jackson (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6328

The primary purpose is to extend heterogeneous nucleation theory to the chemical vapor deposition (CVD) case. Specifically, the critical supersaturation ratio required for the nucleation of a solid phase from a vapor beam of chromous iodide molecules was studied as a function of substrate temperature for an amorphous substrate (fused quartz, 11 substrate temperatures from 164° to 343°C) and a crystalline substrate (single-crystal sapphire, 23 substrate temperatures from 85° to 939°C). At the lower temperatures, the species nucleated was chromous iodide. At the higher temperatures, chromium was nucleated on sapphire substrates as a result of the supersaturation imposed by the thermal decomposition of chromous iodide; on fused quartz substrates in the temperature region where CVD obtains, however, chromium reacts with the quartz to the extent that Cr_3Si and/or Cr_2O_3 completely covers the substrate before a chromium deposit is formed. Dissert. Abstr.

N68-21839*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ATOMIC TRANSITION PROBABILITIES: NEW MEASUREMENTS FOR LIGHT ELEMENTS
Myron H. Miller Nov. 1967 12 p
(Grant NsG-359)
(NASA-CR-93928; BN-520) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A list of newly measured atomic transition probabilities is given for visible lines of carbon, sulphur, phosphorous and silicon, *i.e.*, CI, SI, SII, PI, PII, SiI and SiII. These results are communicated while final publications are being prepared, so that the numbers can be of use in astrophysical abundance determinations, etc. The spectroscopic source is a gas-driven shock tube operating between 9000 and 13000°K. Plasma conditions are directly determined by a variety of methods, including some new ones which automatically circumvent temperature errors. The list of line strengths covers 136 lines, 84 of which are unblended in the shock tube spectra. The 46 multiplets involved include 39 which are observed in their entirety, 28 of these being fully resolved. Upper limit estimates are attached to 31 additional lines, 17 of which are unblended. Accuracies as well as precisions are typically 20%; the range of accuracies is 10% to 40%. A few numbers may be changed by small amounts in a final review of the data; any such modification will be reported in published papers which will also give full details of procedures, results, and comparisons with theory. Author

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-20656# Air Force Cambridge Research Labs., Bedford, Mass.
SCINTILLATION STUDIES USING THE EARLY BIRD SYNCHRONOUS SATELLITE 136 MHZ SIGNAL
Frederick F. Slack Dec. 1967 19 p refs *Its* Environ. Res. Papers, No. 278
(AFCRL-67-0655; AD-665852)

A three-station receiving network was established for receiving VHF radio signals from a synchronous satellite for the purpose of

studying scintillations in the upper atmosphere. The results obtained with a narrow-beam high-gain antenna and those obtained with a wide-beam antenna during a 5-hr nighttime scintillating period were compared. Stations using four-element Yagis with 40 degrees beamwidths measured scintillation index values that varied from 2 percent to 90 percent. The AFCRL Sagamore Hill Radio Observatory receiving station, using a 150-ft antenna with a 4 degree beamwidth, measured scintillation index values that were quite consistently about 50 percent of the values obtained with Yagis. For part of the scintillating period, an 84-ft antenna with a 7 degree beamwidth was used in addition to the 150-ft antenna; the recorded pattern was almost identical with the pattern produced by the other narrow-beam antenna but the scintillation index values were about 66 percent of the Yagi values. Author (TAB)

N68-20657# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.

AN AUTOMATIC NOISE WHITENER FOR SIGNAL CORRELATION SYSTEMS

C. Nicholas Pryor 2 Jan. 1968 24 p

(NOLTR-67-197; AD-665787)

A device has been developed for automatically whitening the spectrum of input signals to a correlation signal processing system. This device consists of a number of narrow band filters, whose outputs are clipped, filtered again, and recombined to form the whitened output. The device is described and its performance against strong interfering single-frequency noise presented. Author (TAB)

N68-20659# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

ANTENNA RADIATION PROPERTIES IN PRESENCE OF ANISOTROPIC PLASMAS

M. P. Bachynski, B. W. Gibbs, and K. A. Graf Jun. 1967 93 p refs

(Contract AF 19(628)-4071)

(RCA Res. Rept.-7-801-58; AFCRL-67-0623; SR-5; AD-665880)

An extensive quantitative experimental investigation has been conducted on the influence of a magnetic field on the radiation from a horn antenna situated behind a layer or sheath of plasma. The magnetic field direction was along the principal direction of radiation of the antenna which is normal to the layer of plasma. The experimental results were compared to theory based on the reciprocity theorem. For an isotropic plasma and for the left-hand circularly polarized wave satisfactory agreement between theory and experiment was obtained. Propagation effects at off-normal incidence corresponding to the condition where the ordinary wave mode switches to the extra-ordinary wave mode as the electron density passes through the critical density, are shown to be of importance for the radiation patterns of the left-hand circularly polarized wave. For the right-hand circularly polarized wave mode radiation pattern significant departures in the measurements from theory occur in the region of the electron cyclotron frequency and below. For values of the electron cyclotron frequency greater than the wave frequency, satisfactory correspondence between theory and experiment is found. Author (TAB)

N68-20679 New Mexico Univ., Albuquerque.

ON THE APPLICATION OF BAYESIAN LEARNING IN DISCRETE COMMUNICATION SYSTEMS

Chien Fong Chao (Ph.D. Thesis) 1967 92 p

Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-6233

The structure of Bayes' learning process for finite observations and its applications to coded communication systems of time varying channels are investigated. The coding systems considered are codes of constant binary symmetrical channels, and the transmission rate of the code will be adaptive according to the estimated channel. The length of observation time is limited to the effective constraint length of the code. With the observation time thus restricted, the effects of the prior information of Bayes' learning process are investigated for a proposed class of prior learning function. The analysis of rate adaptation for the block codes is based on the concept of maximum likelihood decoding of this class of codes. When the estimated channel parameter is the mode of Bayes' learning function, the expected error probability of the adaptive coding system is shown to be the sum of the uncertainty function and the error probability of the system if the channel is known. Dissert. Abstr.

N68-20735# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.

THE EFFECT OF LINEAR FREQUENCY MODULATION ON ANGULAR RESOLUTION AND POINTING ACCURACY

G. O. Young Sep. 1967 92 p refs

(Contract AF 19(628)-4358)

(P67-246; AFCRL-67-0680; SR-7; AD-665456)

The effect of linearly frequency-modulated signals on angular resolution and pointing accuracy is analyzed for a linear differencing interferometer, a directive two-element (summing) array, and a frequency-modulated product array. The exact space-time response of each array is computed, and it is shown that, in the absence of noise, resolution and accuracy can be improved by making the rate of change of frequency as large as possible for as long a time as possible. The magnitude of both these quantities is limited by practical considerations, the effects of noise in both receiver and object region, and the nature and properties of the target. It is shown that, when the signal-to-clutter ratio is high enough and there are only a few targets, the product array is superior to the conventional summing array. It is also shown that frequency modulation may be employed with linear rather than product demodulation; linear demodulation decreases pointing accuracy (on a single target) and resolution capability (for incoherent targets) but eliminates the interaction of multiple targets and clutter. Author (TAB)

N68-20766# Stanford Research Inst., Menlo Park, Calif.

THE OPERATIONAL VALIDATION OF THE CURTS CONCEPT USING 2400-BAUD AUTODIN, PAR 2 Final Report

Karl D. Felperin, Thomas I. Dayharsh, John L. Ramsey, and Bruce C. Tupper Jan. 1968 123 p refs

(Contract DCA-100-67-C-0068)

(AD-665807)

The second and concluding report is made of a test that was designed to validate the quantitative improvement (over normal procedures) obtained by the CURTS (Common User Radio Transmission Sounding) Phase 2 Automatic Frequency Selection System. The system directed frequency changes on three DCS trunks--Okinawa, Guam, and McClellan--terminating at Hickman Air Force Base, Hawaii. Major conclusions of the experiment are: (1) The results of this test have validated the success of the CURTS concept for operational DCS use. (2) The CURTS Phase II system was capable of directing frequency changes with a minimal amount of human interpretation. (3) The CURTS system has proved itself superior to normal frequency control procedures by: (a) improving average throughput between 4.5 percent and 9 percent at the above-90 percent level; (b) reducing the standard deviation of throughput by approximately one-half; (c) increasing user availability by 13.6 percent to 22 percent to achieve a user availability of close to 95 percent at the 90 percent throughput level; and (d) structuring frequency resources to achieve an improvement in user availability of 18.3 percent, in addition to that obtained by real-time frequency selection in (c). (4) When good frequency selection procedures are employed with an adequate complement of frequencies, the benefits of forward error correction are, at most, minimal. (5) The number and duration of outages attributable to propagation have been greatly exaggerated. Author (TAB)

N68-20793 Purdue Univ., Lafayette, Ind.
ANALYSIS OF A WIDEBAND RANDOM SIGNAL RADAR SYSTEM
Ronald Lee Michael Gasaner (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-5430

This study is concerned with the analysis of a radar system transmitting a signal from a wideband random noise process and employing a correlation receiver to estimate target range and range rate. The system analyzed uses a correlator which actually estimates only the envelope of the crosscorrelation function of the transmitted and received random signals. The digital polarity-coincidence correlator is analyzed in several configurations, using both digital and analog integration, and expressions for the output signal-to-noise ratio are developed in each case. Low input signal-to-noise ratios are assumed throughout and specific numerical examples are given. The resolution capabilities of the random signal radar system are investigated also. It is shown that the ambiguity function for this system is separable into range and range rate resolution functions, each of which is independent of the other, thus permitting great freedom in shaping the ambiguity function as desired. Dissert. Abstr.

N68-20838# Montana State Univ., Bozeman. Electronics Research Lab.
REVIEWS OF KALMAN FILTER AND OTHER ALGORITHMS CONSIDERED
Robert C. Minnick, Donald A. Rudberg, and Craig K. Rushforth 29 Sep. 1967 23 p refs
(Contract N00014-67-C-0477)
(AD-665333)

Three general problem areas have been considered: (1) Kalman filtering and prediction, (2) dynamic programming, and (3) Bose-Chaudhuri-Hocquenghem (BCH) decoding. All three have well-defined procedures to follow in their operation and are mechanizable from that standpoint. Of the three, Kalman filtering has been chosen for development in a specially organized machine. Author (TAB)

N68-20846*# California Univ., Berkeley. Space Sciences Lab.
GAIN MEASUREMENTS OF STANDARD ELECTROMAGNETIC HORNS IN THE κ AND κ_a BANDS
Gerard Wrixon Mar. 1968 41 p refs *Its* Ser. 9, Issue 12
(Grant NsG-243; Contract Nonr-222(54))
(NASA-CR-93969) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Measurements are described in which the gain of the standard horns in the κ and κ_a bands were determined at a number of frequencies. The two-antenna method was used. It is believed, after a detailed error analysis, that the gain is known to well within $\pm$ 0.1 db at each frequency measured. The gain of the κ-band horn was also determined at one frequency by numerically integrating the power pattern. This resulted in a gain value which confirmed that obtained using the two antenna method. Author

N68-20856 Ohio State Univ., Columbus.
PREDICTION OF BANDLIMITED SIGNALS
Larry Cooper Mackey (Ph.D. Thesis) 1966 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6343

The subject of this dissertation is the prediction of band-limited signals by using signal samples taken only in the past at a rate of $4f_0$ samples per second. Since the samples are taken only in the past, the average sampling rate over all time is $2f_0$, which is the same sampling rate required by the fundamental sampling theorem. Two restrictions are placed on the bandlimited signals to be predicted: (1) the fundamental sampling theorem can be written as the sum of two infinite series, and (2) if the bandlimited signal is considered as a voltage exciting a one-ohm resistor, then the total energy dissipated in the resistor must be finite. With these two restrictions a method of representing a bandlimited signal by two Hilbert vectors is presented. It is then shown that these Hilbert vectors and, hence, the signal they represent can be approximated with arbitrarily small error by vectors with a finite number of dimensions. This vector representation of a bandlimited signal is used to show that an arbitrarily small error is made in the prediction of the signal. Dissert. Abstr.

N68-20897# Ohio State Univ., Columbus. Electroscience Lab.
ANALYSIS OF ECHO AREA OF TARGETS USING GEOMETRICAL THEORY OF DIFFRACTION AND CREEPING WAVE THEORY Quarterly Technical Report, 1 Jul.–30 Sep. 1967
Bedford, Mass. AFSC, Electron. Systems Div. Oct. 1967 24 p refs
(Contract F19628-67-C-0308)
(OSURF-2430-2; ESD-TR-67-616; QTR-2; AD-665856)

The report describes the progress accomplished in the past quarter on the direct-scattering computer program, its anticipated capabilities and limitations, and mathematical description of the target, the details of the physical-optics formulation, and recommendations for a subsequent computer program improvement effort. Author (TAB)

N68-21027# Missouri Univ., Columbia. Information Systems Simulation Lab.
TIME DOMAIN SYNTHESIS OF FINITE MEMORY DIGITAL FILTERS USING ORTHOGONAL POLYNOMIALS
T. A. Brubaker and J. B. Peterson Oct. 1967 8 p refs Prepared for Calif. Univ., Lawrence Radiation Lab.
(Contract W-7405-ENG-48)
(Rept.-2; UCRL-13326) CFSTI: HC $3.00/MF $0.65

Filtering is the process of transforming data from an experiment or process into a form which is more acceptable for analysis by a computer and/or a person. In the past, most filtering has been accomplished by use of analog devices; however, the increasing speed and decreasing size and cost of digital components now permit the economical use of digital filters to perform many desired filtering operations. A method for time domain synthesis of finite memory digital filters using orthogonal polynomials is presented. The use of orthogonal polynomials permits filter coefficients to be determined without any matrix inversion so that the method is well suited for on-line real time design using a digital computer. Author (NSA)

N68-21033# Sandia Corp., Albuquerque, N. Mex.
THE MEANING OF RECEIVER NOISE FIGURE IN THE PRESENCE OF A HOT PLASMA SHEATH
R. J. Chaffin Jan. 1968 20 p refs
(Contract AT(29-1)-789)
(SC-RR-67-2964) CFSTI: HC $3.00/MF $0.65

Two models are examined to determine the effects on receiver noise figure of hot plasma surrounding a reentering space vehicle. Author (NSA)

N68-21114# General Electric Co., Syracuse, N. Y. Electronics Lab.
ELEMENT THINNING IN LARGE ARRAYS
W. H. Nester Nov. 1967 24 p Presented at the 17th Ann. USAF Antenna Symp.
(R67ELS-91)

The influence of element thinning in large phased arrays is discussed in terms of array gain, sidelobe distribution, average sidelobe level, and confidence levels on sidelobes. The optimum density weighting policy for maximum gain or minimum average sidelobe is derived by variational techniques under the constraints of a specified reference pattern and of a specified thinning ratio. By element thinning, it is meant a substitution of passive elements for active elements in a regular grid of elements over portions of the array. Author

N68-21180# General Electric Co., Schenectady,. N. Y. Research and Development Center.
DISK-ANTENNAS
C. L. Andrews Sep. 1967 15 p refs
(Rept.-67-C-351)

A study has been made of disk antennas excited in the simplest modes. Both the radiating and nonradiating components of the waves were measured. Calculations consisting of additions of Young--Huygens wavelets from line elements of edge were compared with measurements of the waves of normal electric field and waves of tangential magnetic field over the metal surface. An extensive study was made to probe errors, with the conclusion that it is possible to measure the electric and magnetic boundary conditions over the surfaces of metal antennas and diffracting objects. Author

N68-21198# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut fuer Flugfunk und Mikrowellen.
ON NEAR ZENITH SATELLITE TRACKING [ZUR EL-UEBER AZ-NACHSTEUERUNG VON SATELLITENEMPFANG-SANTENNEN BEI ZENITANAHEN DURCHGAENGEN DES SATELLITEN]
R. Schimmel Feb. 1968 30 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-68-02; DVL-695) CFSTI: HC $3.00/MF $0.65

The difficulties are discussed which arise when a close earth satellite near zenith is tracked with an el-az-antenna. Two methods are explained to avoid large deviations of the antenna from the satellite direction. The tolerable prediction time error is given for a maximum antenna deviation of 6°. The calculations are based on the orbit parameters of the German satellite 625 A-1. Author

N68-21246# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A NEW CLASS OF CYCLIC CODES AND AN ASSOCIATED DECODING METHOD
M. C. Jeruchim 23 May 1967 108 p refs
(Rept.-67SD254)

Consideration is given to a class of binary cyclic error-correcting (n,k) codes which are characterized by the generator polynomial $g(X) = (X^n+1)/h(X)$ such that $n = 2^m-1$, $k = rm$ or $rm + 1$ and $h(X)$ is a product of r primitive polynomials of degree m. The distance properties of these codes are obtained. It is concluded that the structure of the codes suggests a decoding procedure which, compared to other methods, appears quite efficient for low rates or, equivalently, for large error-correcting capability. Author

N68-21315# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
A NOTE ON MULTIPLE ACCESS TO TACTICAL COMMUNICATION SATELLITES: NETS, NETWORK CONTROL, AND RANDOM ACCESS
Thomas G. Belden and Jay W. Schwartz Dec. 1967 17 p refs
(Contract DAHC15-67-C-0011)
(P-360 IDA/HQ-67-6644; AD-666540)

The document questions the importance, and even the desirability, of random access for a communication satellite designated to service tactical communications. The desirability of random access for a tactical communication satellite has achieved wide acceptance. Some proposals for multiple access systems to be used with tactical communication satellites have discarded candidate systems because they do not provide the potential for random access. However, the characteristics of random access are most useful for a network of users such as that served by the public telephone system. Tactical communications possess two characteristics which distinguish its users from those of the telephone system: (1) Crisis Operation. A most important measure of a tactical communication system is how well it operates in times of crisis when communication traffic is abnormally great. (2) Coordinated Use. Users tend to organize into functional groupings for which netted communications are very useful. Author (TAB)

N68-21321# New York Univ., N. Y. Dept. of Electrical Engineering.
ANALYSIS AND SIMULATION OF WORD SELECTION PROCEDURES IN ERROR-FREE COMMUNICATION SYSTEMS. PART 2: PRESENTATION AND EVALUATION OF DATA
John T. Metzner and Kenneth C. Morgan Oct. 1967 44 p refs
(Contract AF 19(628)-4321)
(TR-400-169; SR-5; AFCRL-67-0594; AD-666030)

This part presents and evaluates data obtained from the computer simulations of digital feedback communication word-selection procedures described in Part I. Curves are presented showing the effect on communication efficiency of a constraint on the location difference between newest and oldest unconfirmed work for two different procedures - the circulating memory procedure and the interlaced memory procedure. Author (TAB)

N68-21333# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SCATTERING PATTERNS AND STATISTICS OF A LONG WIRE
Soonsung Hong 26 Dec. 1967 28 p refs
(Contract AF 19(628)-5167; ARPA Order 498)
(TN-1967-55; ESD-TR-67-593; AD-666472)

The backscattering cross section and pattern of wires 2 to 18.5 wavelengths long were theoretically computed and plotted. Assuming a spherically random orientation of the wire, the report presents the average cross sections and probability distributions for various lengths and radii of the wire. Author (TAB)

N68-21427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATIONAL RELIABILITY OF RADIO RELAY LINES [EKSPLUATATSIONNAYA NADEZHNOST'RADIORELEY-NYKH LINIY]
D. A. Bunin 19 Sep. 1967 14 p Transl. into ENGLISH from Avtomat., Telemekh. i Svyaz' (Moscow), no. 1, 1966 p 12–15
(Contract AF 33(657)-16410)
(FTD-HT-67-68; AD-665985)

Statistical data on the reliability of 15 radio-relay lines (RRL) totaling 4000 km and having 96 stations with RM-24 type equipment and one 272-km RRL having 21 stations with RTA-24 type equipment is reported; all lines are serving railroads. Equipment failures are responsible for 40-55% of the total number of failures; power-supply failures, for 27-41% strong fadings, for 5-33% . The above figures testify to the low reliability of Soviet railroad-serving RRLs. Steps for enhancing the reliability by various reserving techniques are discussed. Author (TAB)

N68-21428# Battelle Memorial Inst., Columbus, Ohio.
RADAR SIGNAL SPECTRUM DISTORTIONS PRODUCED BY VOLUME AND SURFACE DISTRIBUTED SCATTERERS
Donald E. Barrick 1968 22 p refs Presented at USNC/URSI Spring Meeting, Washington, D. C., 9–12 Apr. 1968

An attempt is made to briefly discuss all of the known mechanisms which produce spectral distortions on an incident signal after scatter from distributed sources. The signal length and its relationship to signal spectrum is evaluated along with spectral distortion due to relative motion and finite beamwidth. A mechanism which produces spectral spreading when a moving radar antenna looks at scatterers distributed throughout the resolution cell is investigated, and spectral distortion due to volume scatterer velocity differences, such as raindrops, is considered. Spectral distortion from the sea surface due to surface movement is discussed in relation to a slightly rough surface, very rough surface, and a composite surface. It is shown how one combines these various

known physical mechanisms, which distort the spectrum, to obtain the total spectrum of the received signal. B.S.D.

N68-21468# New York Univ., N. Y. Dept. of Electrical Engineering.
ERROR DETECTION CONSIDERATIONS IN NULL RECEPTION SYSTEMS Interim Scientific Report
Stephen Dobrow Oct. 1967 28 p
(Contract AF 19(628)-4321)
(TR-400-170; AFCRL-67-0638; SR-8; AD-666032)

The use of error detection in conjunction with error correction and erasure fill-in is considered. The residual guaranteed error detection ability when the full guaranteed error correction ability is attempted is determined. The trade-off in the exchange of error correction capability for increased error detection capability is determined. The effect of multiple transmission is also considered. Author (TAB)

N68-21474# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
ANTENNA PROPERTIES IN THE PRESENCE OF ANISOTROPIC IONIZED MEDIA Final Report, Feb. 1965–Mar. 1967
M. P. Bachynski, B. W. Gibbs, and K. A. Graf Jun. 1967 124 p refs
(Contract AF 19(628)-4071)
(RCA Res. Rept.-7-801-60; AFCRL-67-0625; AD-666033)

A detailed quantitative experimental and theoretical investigation was conducted of: (1) The propagation of electromagnetic waves in an anisotropic plasma along the direction of an applied static magnetic field. (2) The mismatch or power reflected by an anisotropic layer of plasma. (3) The influence of a magnetic field on the radiation from a horn antenna situated behind a layer of plasma. The magnetic field in the experiment was along the principal direction of radiation of the antenna which is normal to the layer of plasma. Good agreement between measurements using various polarization of the electromagnetic field and theory was in general obtained. TAB

N68-21481# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
TELEMETRY AND DATA PROCESSING [TELEMETRIE UND DATENVERARBEITUNG]
Ph. Hartl *In* Tech. Hochschule Carolo Wilhelmina The Exploration of the Planet Jupiter Dec. 1967 p 147–165 (See N68-21476 11-30)

This review covers all aspects of a representative ground and spacecraft telemetry and data processing system suitable for a Jupiter mission. The problems peculiar to such a system are discussed, including the extreme signal attenuation due to the distances involved, noise, antenna gain, mission duration, and the role of the Deep Space Instrumentation Facility in a Jupiter mission. Transl. by K.W.

N68-21493# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
SCATTERING FROM ROUGH SURFACES FOR FINITE DISTANCES BETWEEN TRANSMITTER AND RECEIVER
Peter Beckman Oct. 1967 39 p refs
(D1-82-0657; AD-666593)

The report investigates scattering from a rough surface when transmitter and receiver are at a finite distance from each other, so that the sphericity of the incident and scattered waves has to be taken into account. The calculation is complicated by the fact that, unlike the case of plane waves, the equiprobability planes of the surface do not coincide with the equiphase surfaces, therefore, a number of simplifying assumptions are made, in particular, geometric optics are used. The phase distribution of the scattered field is given by approximate integrations; from this, the other quantities of interest can be found. The results are compared with the measurements performed by Beard using microwaves and a random water surface with known statistical properties. Author (TAB)

N68-21523# General Electric Co., Schanectady, N. Y. Research and Development Center.
THE ESTIMATION OF PERIODIC SIGNALS IN NOISE
Thomas G. Kincaid and Henry J. Scudder, III Feb. 1968 35 p refs
(Contract Nonr-4692(00))
(S-68-1019; AD-666580)

The report presents two methods for the estimation of a periodic signal in additive noise. Both methods assume that only a finite time sample of the signal plus noise is available for processing. The estimate of the signal is chosen to minimize the mean square error between the estimate and the sample of signal plus noise. This is also a maximum likelihood estimate if the noise is white and Gaussian. The first method is frequency domain analysis. Estimates for the period of the signal and the complex amplitudes of its harmonics are derived. The second method is time domain analysis. Estimates for the period of the signal and for the waveform of one period are derived. Under the assumption of white noise and large signal-to-noise ratio, formulas for the expected values and variances of the period estimates are derived. The estimates for the period are found to be the same by both methods. The estimate is unbiased and has a variance inversely proportional to the signal-to-noise ratio, and inversely proportional to the cube of the number of periods in the given sample. The expected values of the estimates of the waveform itself are derived, and the estimates are found to be biased. Author (TAB)

N68-21524# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THEORETICAL AND EXPERIMENTAL STUDIES ON THE LONG DIPOLE ANTENNA
Chin-Lin Chen Oct. 1967 47 p refs
(Contract Nonr-1866(32))
(TR-541; AD-666307)

The problem of a long transmitting dipole antenna is studied theoretically and experimentally. The Wiener-Hopf technique is used to solve the problem. Explicit expressions for the current and charge distributions along the antenna are obtained. These quantities are also measured. The theoretical and experimental results are in good agreement. Author (TAB)

N68-21539*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT ANTENNA POINTING WITH A SINGLE DEGREE OF FREEDOM
Gerald E. Fleischer 15 Mar. 1968 47 p refs
(Contract NAS7-100)
(NASA-CR-94153; JPL-TR-32-1255) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A computer program which aids and evaluates the design of a single-degree-of-freedom spacecraft antenna-pointing system has been developed. The program includes algorithms for determining an optimum location for the antenna's rotational axis and for fitting a function of connected line segments to the ideal antenna angular-rotation function. An onboard sequencer can then command antenna rotations according to the stored line-segment function. Specific examples of the program's application to a Jupiter flyby mission are presented, including the evaluation of major sources of pointing error. Descriptions of the program operation and its input formats are also given. Author

N68-21545# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TELEVISION EQUIPMENT FOR SCIENTIFIC INVESTIGATIONS OF THE COSMOS [TELEVIZIONNAYA APPARATURA DLYA NAUCHNYKH ISSLEDOVANIY KOSMOSA]

P. F. Bratslavets, I. A. Rosselevich, and L. I. Khromov 4 Aug. 1967 20 p refs Transl. into ENGLISH from Tekhn. Kina i Televideniya (Moscow), no. 10, 1966 p 18–23
(FTD-MT-24-137-67; AD-666071)

The newest problem in television for space is the development of a single system which will incorporate the best features of the presently implied three distinct systems for conveying the images of cosmic bodies over great distances. The single-element system collects the light flux from an elementary area of the observed surface through mechanical scanning and converts it into current by means of a photomultiplier tube, after which it is handled as a video signal; the phototelevision system, implies a photographic method with camera, film, developer, plus film reader; the small frame system, employs frequency-band compression based on the elimination of the subjective redundancies of photographed images by means of a camera shutter; these have different advantages and disadvantages and are used for different desired results. Combining them into a single system for all TV transmission from space seems out of the question at the present time. The article gives the fundamentals of the three types of operation, block diagrams and a photograph of a phototelevision system. Author (TAB)

N68-21551# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.

BEAM WIDTH AND CURRENT DISTRIBUTION FOR CIRCULAR-ARRAY ANTENNAS: TABLES Research and Development Report, Mar.–Sep. 1967

A. D. Munger and J. H. Provencher 26 Oct. 1967 483 p refs
(NELC-1522; AD-666313)

Beam width and amplitude and phase distribution required for Tchebycheff-type patterns are presented for two basic types of element -- the narrow axial slot and the axial dipole a quarter wavelength above a metal cylinder. The distributions for other types would be similar. Distributions for arrays of 16 to 256 elements are included, with design side-lobe levels from -20 to -50 dB. Current modes are also given, for use in designs which require individual excitation of the modes, rather than excitation of the sums of the modes. Author (TAB)

N68-21558# Delaware Univ., Newark. Dept. of Electrical Engineering.

POISSON TRANSFORM CHARACTERIZATION OF PHOTOELECTRIC COUNTS

Leslie Earl Jacobs Jun. 1967 49 p refs
(Grant AF-AFOSR-2-67)
(Q-71; AFOSR-68-0033; AD-666468)

The photodetector is inherently a quantum mechanical device, which produces an electric current when exposed to light. The number of electrons emitted in a given time can only be described statistically. Nevertheless, the device is of significant interest in the field of optical communications. Previous work has shown that if a tractable formula describing the probabilistic behavior is available for the photoelectrons, then a statistical description of the incident light may be formally obtained. This thesis arrived at the same result, with the development proceeding in an alternate manner. Several methods which may be of practical value in effecting this result are discussed. Within the thesis it is also demonstrated that the mathematics describing the statistical behavior of photoelectrons may be used in describing a new sampling theorem for communication theory. Author (TAB)

N68-21559# New York Univ., N. Y. Lab. for Electroscience Research.

FEEDBACK COMMUNICATION SYSTEMS 2 Final Report, 15 Oct. 1964–14 Oct. 1967

John J. Metzner 14 Nov. 1967 27 p refs
(Contract AF 19(628)-4321)
(AFCRL-67-0408; TR-400-171; AD-666441)

The contents of eight scientific reports are described. Most of the work is included in one of three categories: (1) Logical procedures in coded error-free feedback communication systems; (2) Methods of improving the efficiency and adaptivity of such systems; and (3) Modelling of channel characteristics. The relation of this work to work on a previous contract is shown, and some promising areas for future research are also specified. Author (TAB)

N68-21577*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

INTERCOMPARISON OF THE MINITRACK AND OPTICAL TRACKING NETWORKS USING GEOS-1 LONG ARC ORBITAL SOLUTIONS, PART 1

J. G. Marsh, C. E. Doll, R. J. Sandifer (Wolf Res. and Develop. Corp., College Park, Md.), and W. A. Taylor (Wolf Res. and Develop. Corp., College Park, Md.) Dec. 1967 71 p refs
(NASA-TM-X-63161; X-522-68-105) CFSTI: HC $3.00/MF $0.65
CSCL 17I

The Stadan Minitrack network data are analyzed using an optically determined standard orbit of 5-1/4 days in length as a reference orbit. The standard orbit has an RMS fit of 3."0. It is shown that this is adequate for evaluating Minitrack data. The standard orbit is based primarily upon GEOS-I flashing lamp sequence observations. A Minitrack orbit for the same time period as the optical orbit was obtained with an rms fit of 0.19×10^{-3}. The Minitrack data used in this particular solution were not corrected for ionospheric or tropospheric refraction and were not weighted for elevation effects. Data down to 15° elevation were used in the solution. Positions differences between the minitrack and optical orbits produced an rms deviation of approximately 165 meters. This low figure is due in part to the use of an accurate gravity model and station positions consistant with this gravity model. Author

N68-21581# Mitre Corp., Bedford, Mass.

A STRAIGHTFORWARD GENERAL ANALYSIS OF SIGNAL DISTORTION WITH APPLICATIONS TO WIDEBAND IONOSPHERIC DISPERSION

J. T. Lynch Mar. 1968 84 p refs
(Contract AF 19(628)-5165)
(MTR-444; ESD-TR-67-623; AD-666428)

The degradation of signal processor performance in terms of loss of resolution (i.e., increased main lobe width and increased sidelobes) is analyzed and calculated for dispersive media. The analysis gives insight into the distortion mechanisms and compares well with straightforward and precise numerical calculations. The distortion of wideband signals is described for the following situations: ionospheric dispersion (above plasma frequency), waveguide operated near cutoff, time dilation, and frequency dependent cross section. Author (TAB)

N68-21584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFORMATION TRANSFER IN AN IDEAL PHOTON CHANNEL [PERENOS INFORMATSII V IDEAL'NOM FOTONNOM KANALE]

L. B. Levitin 14 Sep. 1967 18 p refs Transl. into ENGLISH from Probl. Peredachi Inform. (Moscow), v. 1, no. 3, 1965 p 71–80
(FTD-MT-24-151-67; AD-666157)

The author investigates a three-dimensional photon information transmission channel, i.e., an electromagnetic channel with a spatial variation of the wave vectors. Let an electromagnetic signal with the average power of P and thermal emission (noise) of the temperature T1 be incident on an area S. The source of emission is visible from every point of the area S at the spatial angle omega. (It will be assumed that the point incidence is normal and that

omega/4 pi is much < 1. Then the result will depend only on the magnitude and not on the form of the spatial angle). It is also assumed that the conditions of justification for the approximation of the geometric optics are satisfied. The author is interested in the question of information which may be transmitted in a unit of time under the conditions listed, i.e., the transmission capacity of such a channel. The transmitter and the receiver are both considered ideal. The author shows the equivalency of the transmission of information by means of representation in momentum space and by means of representation in the ordinary sense, with variations in time. TAB

N68-21590# Naval Research Lab., Washington, D. C.
A FORTRAN PROGRAM FOR VLF MULTIMODE PROPAGATION PREDICTIONS
J. H. McCabe, C. B. Brooks, Jr., and F. J. Rhoads 19 Jan. 1968 43 p refs
(NRL-MEMO-1849; AD-666563)

The VLF Multimode propagation prediction equations are given and discussed briefly. The Fortran program for numerical calculation of these equations and for plotting and tabulation of the results is presented. Sample runs are included for given parameters. Usage and capabilities of the program are discussed. Author (TAB)

N68-21599# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
LARGE TIME-BANDWIDTH PRODUCT MODULATION EXPERIMENTS AT 94 GHZ
Larue A. Hoffman, Dale E. Kind, and Herbert J. Wintroub Sep. 1967 27 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-46)-3; SAMSO-TR-68-77; AD-666423)

Effort has been proceeding on a large time-bandwidth radar to operate at the 94-GHz atmospheric window for use in satellite identification experiments. Results of preliminary pulse compression experiments are discussed, as well as progress in other critical areas including a low-noise balanced mixer, a 1-kW duplexer, and a low-loss beam-waveguide. Author (TAB)

N68-21609# Mitre Corp., Bedford, Mass.
EFFECT OF RADAR SYSTEM INCOHERENCE ON ACHIEVABLE MAINLOBE WIDTHS AND SIDELOBE LEVELS
John T. Lynch Electron. Sys. Div. Feb. 1968 60 p refs
(Contract AF 19(628)-5165)
(MTR-488; ESD-TR-67-427; AD-666429)

The loss in radar resolution, that is, the increase in mainlobe width and sidelobe level, has been computed for signals corrupted by a stationary random phase process. By making approximations appropriate to a coherent radar, an easily interpreted analysis is possible. The application to a CW radar or a pulsed radar using a reference oscillator with broadband phase errors is straightforward and indicates that a hash sidelobe level is introduced. A more general application, which corresponds to a crystal oscillator reference with narrowband phase errors requires the calculation of a convolution. Hash sidelobes are introduced in this case also, except that their level is a simple function of the ratio of the phase error and signal bandwidth. Author (TAB)

N68-21610# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE USE OF COMPOSITE SIGNALS AT VERY LOW RADIO FREQUENCIES Interim Technical Report
J. A. Pierce Feb. 1968 36 p refs
(Contract N00014-67-A-0298-0008)
(TR-552; AD-666567)

When the time of arrival of a VLF transmission is measured at two frequencies the two components can be combined to form a composite signal. This signal, when the transmission is chiefly determined by a single mode of propagation, has advantages in stability and predictability as compared with either one of the carrier-frequency signals or with the difference-frequency signal. Author (TAB)

N68-21658# Naval Avionics Facility, Indianapolis, Ind. Applied Research Dept.
MICROELECTRONIC RADAR RECEIVER HELCAR 3
Robert F. Wyrick 30 Jan. 1968 49 p
(NAFI-TR-1109; AD-666552)

The report outlines the objectives and design effort pertaining to the HELCAR III receiver system, and discusses the problems encountered in meeting these objectives. Recommendations for improvement of future models and a description of the circuitry of the system are also included. Complete parts lists, schematic diagrams, and the receiver alignment procedure are provided for future use. Author (TAB)

N68-21660*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVALUATION OF THE GODDARD RANGE AND RANGE RATE SYSTEM AT ROSMAN BY INTERCOMPARISON WITH GEOS-1 LONG ARC ORBITAL SOLUTIONS
Francis J. Lerch, James G. Marsh, and Brian O'Neill (Wolf Res. and Develop. Corp., College Park, Md.) Nov. 1967 81 p refs
(NASA-TM-X-63159; X-552-68-72) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The range measurements of the Goddard Range and Range Rate (GRARR) S Band Tracking System at Rosman, North Carolina have been evaluated using long arc optical reference orbits as a standard. The optical reference orbits were determined from GEOS-I flash sequence data sets and some optical passive data from five major geodetic optical tracking networks. Thirty passes of range and range rate measurements consisting of all GRARR passes from the GEOS-I satellite, during two periods in January 1966, were evaluated. The observed range measurements were compared with values calculated from the optically determined reference orbits. For each pass, a zero-set range bias, timing error, and random error were estimated from the residual differences between the observed and calculated ranges. Author

N68-21678*# National Aeronautics and Space Administration. Goddard Space Flight Center.
THE DETERMINATION AND COMPARISON OF THE GRARR MADGAR SITE LOCATION
Francis J. Lerch, Clarence E. Doll, Samuel J. Moss (Wolf Res. and Develop. Corp., College Park, Md.), and Brian O'Neill Oct. 1967 40 p ref
(NASA-TM-X-63154; X-552-67-540) CFSTI: HC $3.00/MF $0.65 CSCL 17I

Improved coordinates for the MADGAR range and range rate site were estimated from GEOS-I data sets using the NONAME orbit determination program. These coordinates were compared with a preliminary estimate obtained under contract with Goddard Space Flight Center by the Applied Physics Laboratory using thirty-nine passes of SRN-9 Doppler data from three satellites. Two independent estimates were obtained using the NONAME orbit determination program; one estimate was obtained from optical flash sequence data taken at 1TANAN (MOTS 40" camera) during July 1966 and the other from range measurements taken at MADGAR during November 1965. The comparison of the Applied Physics Laboratory MADGAR location estimate with the optically determined NONAME estimate is shown by plots of the residual differences of the range and range rate measurements from five reference orbits. The five reference orbits were determined solely from optical flash sequence data, and they had a maximum root mean square to fit of less than two seconds of arc. The residual difference for both range and range rate measurements clearly

indicate that a significantly better set of MADGAR coordinates was obtained from the NONAME orbit determination program. Author

N68-21720*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOS-1 STATION TRACKING POSITIONS ON THE SAO STANDARD EARTH (C-5)
Francis J. Lerch, James G. Marsh, Maurice D. D'Aria (Wolf Res. and Develop. Corp.), and Ronald L. Brooks (Wolf Res. and Develop. Corp.) Dec. 1967 65 p refs
(NASA-TM-X-63157; X-552-68-70) CFSTI: HC $3.00/MF $0.65 CSCL 17I

For the purpose of long-arc satellite data reduction and intercomparison, all GEOS-1 participating tracking stations were transformed to a common datum. The common datum selected is the Smithsonian Astrophysical Observatory (SAO) Standard Earth C-5 model, in which the Baker–Nunn station positions are used as the controlling stations for all other stations to be transformed. Descriptions and formulation are presented to effect the transformations from major and isolated datums. An empirical transformation technique is explained in detail which may be employed advantageously when datum shifts (ΔX, ΔY, ΔZ) are not known or when the control stations within a local datum have been allowed to adjust independently on the world datum (SAO C-5). The transformation of local datum station coordinates are important to be performed since the datum shifts are quite large. The center of mass coordinates of the SAO C-5 Baker–Nunn stations are assessed by SAO to have approximately 20 meter accuracy. Original and transformed station positions are presented in geodetic and Cartesian coordinates. Author

N68-21726 Aeg-Kernenergieanlagen, Frankfurt am Main (West Germany).
AIRBORNE TRANSCEIVERS IN BUILDING BLOCK DESIGN [BORD-SENDE-EMPFAENGER IN BAUSTEINTECHNIK]
Th. Radtke Bundesministerium fuer Wiss. Forsch. Aug. 1967 105 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMWF-FB-W-67-21) CFSTI: $3.00

For telemetry and telecommand applications a detailed airborne transceiver system is described. It is built up of a series of widely common assemblies and designed for the international telemetry and telecommand frequency range of 136–8400 Mcs. The advantage of such a system is assured if a serious reliability analysis allows the technical complexity of units for versatile applications. First prototypes of an airborne receiver (149.3 Mcs), an airborne transmitter (136 Mcs) and two microminiature units in thick film technology, an automatic gain controlled IF-amplifier and a crystal controlled oscillator with a phase modulator are described. Author

N68-21789 Princeton Univ., N. J.
ON NONLINEAR FILTERING AND SAMPLING EXPANSIONS
Abraham H. Haddad (Ph.D. Thesis) 1966 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-5721

This study is concerned with two important problems in communication theory; namely, the nonlinear filtering of signals and sampling expansions for band-limited signals. It is composed to two self-contained parts which treat some aspects of these two problems. Part one of this study is concerned with the minimum-mean-squared error (MMSE) nonlinear filtering of signals in additive noise. Methods of analysis, representation, and classification of nonlinear systems are treated. Integral representations and their applicability to random inputs and MMSE filtering are emphasized. The general MMSE nonlinear filtering problem is discussed briefly; the restriction of the filter to general classes of systems or input processes is considered. Usually the general solutions to the problem are difficult and in many cases are impractical; therefore restriction to special classes of systems and special classes of input processes is investigated. Part two of this work presents an integral representation for the derivation of sampling expansions. The presentation is based on a property of the resolvent operator on a Hilbert space. The theory of formally self-adjoint differential operators and boundary-value problems is used to obtain a more explicit expression for the integral representation in terms of the Green's function. Dissert. Abstr.

N68-21813# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMMUNICATION SCIENCES AND ENGINEERING
In its Res. Lab. of Electron. Quart. Progr. Rept. No. 88 15 Jan. 1968 p 232–351 refs (See N68-21810 11-23)

Ten research areas related to the communication sciences and engineering are covered in this summary. Studies deal with statistical communication theory, processing and transformation of information, and detection and estimation theory. Other research considers speech communication, linguistics, cognitive information processing, and communications biophysical detection and models. Fiorello and random nets of formal genes are discussed under the heading of neurophysiology, and attention is given computer research and stroposcopic light research are summarized. M.W.R.

N68-21815# Royal Aircraft Establishment, Farnborough (England).
PATTERN RECOGNITION BY SPATIAL FREQUENCY FILTERING [RECONNAISSANCE DES FORMES PAR FILTRAGE DES FREQUENCES SPATIALES]
S. Lowenthal and Y. Belvaux Dec. 1967 25 p refs Transl. into ENGLISH from Opt. Acta (Paris), v. 14, no. 3, 1967 p 245–258
(RAE-LIB-TRANS-1265) CFSTI: HC $3.00/MF $0.65

The pattern recognition method proposed is characterized by a low false-alarm probability. It consists in applying to the object (signal to be identified+noise) an appropriate differential operator, then in correlating the derived object with the signal to which the same operator has been applied. The ambiguities often encountered in autocorrelation methods are thus avoided and identification remains correct even with a high signal-noise ratio. The whole process is accomplished in a simple way by spatial filtering in coherent light. Author

N68-21842# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS NETWORKS Surveys of Foreign Scientific and Technical Literature
9 Jan. 1968 32 p
(ATD-68-10-33-1; Rept.-9; AD-666454)

Contents: USSR communication equipment; USSR communications facilities and their location; Communications equipment in Communist China. TAB

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-20685 New Mexico Univ., Albuquerque.
A STUDY OF LEARNING IN ADAPTIVE SYSTEMS
In Ku Kang (Ph.D. Thesis) 1967 187 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-6238

The structures of the learning process and their applications to adaptive systems are investigated. The learning processes are based on Bayes' learning model and are constructed in such a way

that they are applicable even if the observations are not classified (unsupervised learning). The concept of a quantized parameter space is introduced to handle a general type of the prior credibility function and unsupervised learning, and is applied to develop the structures of the learning processes for various communication channels. The adaptive detectors, whose performances are arbitrarily close to the optimum, are then developed as applications of these structures. The learning process is also applied to the adaptation of transmission rate according to the channel characteristics and to obtain the channel parameter of a quantized channel from the characteristics of a physical channel. Dissert. Abstr.

N68-20698 Illinois Univ., Urbana.
EDITING COMPILERS, THEIR FEASIBILITY AND EFFECTS
Edwin Bernard Hassler, Jr. (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6625

Feasibility of writing an editing compiler is demonstrated by first showing the problem to be that of delaying inter-statement interaction until run time and then by discussing the necessary techniques using FORTRAN II, FORTRAN IV, and ALGOL 60 as examples. The principal effects of using an editing compiler are that inter-statement error detection is deferred until execution time and intra-statement error detection is immediate. A model based on machine time exclusive of input/output time comparing the editing compiler to a similar conventional compiler for the complete solution of a problem on a von Neumann single-address machine is developed. This mode demonstrates that the intuitive machine time saving realized by reduction in the amount of compilation which must result from the use of an editing compiler is easily nullified by the inefficiencies which must be introduced into the object language program in order to implement the editing compiler. A preliminary machine design removing the restrictions of the von Neumann single-address machine is suggested. Dissert. Abstr.

N68-20737# RAND Corp., Santa Monica, Calif.
DIGITAL COMPUTER SIMULATION: INPUT–OUTPUT ANALYSIS
George S. Fishman Feb. 1968 32 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5540-PR; AD-665830)

Procedures for determining the result of a change in inputs to a system simulation. The study discusses the reliability of an experimental result and describes methods of estimating it. The method recommended uses a single replication and makes use of the covariance stationarity of the underlying stochastic process. The comparative reliability of results for different experiments is also discussed. For comparing experiments, it is suggested that reliability based on equal ratios is often preferable. A procedure for graphical analysis is presented, including a list of transformations of the dependent variable that help to reveal the correct form of the relationship between input and output. The generalized least-squares method for estimating the parameters of the identified form takes into consideration the varying reliabilities of the different results and leads to more efficient estimates than those obtained by the unweighted least-squares method. A procedure is given for predicting the computer time needed for a given input and a specified reliability. Author (TAB)

N68-20763# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC RECOGNITION OF PATTERNS [AVTOMATICHESKOYE OPOZNAVANIYE OBRAZOV]
V. S. Fayn 9 Jun. 1967 10 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), No. 10, 1965 p 127–129
(FTD-HT-66-570; AD-665708)

The First All-Union Symposium on Automatic Pattern Recognition, organized by the Scientific Council on the Overall Problem of Cybernetics of the Academy of Sciences USSR, was held in Moscow from 16 to 18 June 1965. Over sixty papers were presented on the following topics: (1) General problems in pattern recognition; (2) learning automata; (3) recognition of visual and aural patterns, and (4) reading automata. Author (TAB)

N68-20800# Michigan Univ., Ann Arbor. Dept. of Communication Sciences.
AUTOMATION RESEARCH: DESIGN, CONSTRUCTION, COMPLEXITY, ADAPTATION Final Report
Feb. 1968 12 p refs
(Contract Nonr-1224(21))
(Rept.-03105-51-F; AD-665523)

The Office of Naval Research sponsored research program of the Logic of Computers Group of The University of Michigan is reviewed, and principal resulting reports and papers listed. The research first concentrated on showing the existence or non-existence of mechanical design procedures for computing automata. Later research included research on problems of automata which grow and reproduce, and problems of measuring the complexity of machines. Automaton composition decomposition problems were studied employing the methods of group and semi-group theory, category theory, and graph theory. Some problems of adaptation and learning in machines, as well as the relationship between probabilistic and deterministic machines were also examined. Author (TAB)

N68-20803# Center for Naval Analyses, Washington, D. C.
THE DETERMINATION OF A SCHEDULING RULE FOR A COMPUTING CENTER
R. L. Smith Nov. 1967 113 p refs *Its* Res. Contrib. No. 25
(Contract N00014-68-A-0091)
(AD-665687)

The scheduling of computer time is a critical element in providing efficient service to the customers of a computing center. This paper describes the search for a scheduling rule for the computing facility at the Center for Naval Analyses. A queueing model was developed to describe the flow of work through the facility. An event-store Monte Carlo simulation program was written and used to evaluate scheduling rules. Author (TAB)

N68-20835# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Sep.–30 Nov. 1967
Richard O. Duda, Peter E. Hart, and John H. Munson Feb. 1968 27 p refs
(Contract DA-28-043-AMC-01901(E))
(Rept.-29; ECOM-01901-29; QR-7; AD-665391)

This report describes the continuing development of scanning, preprocessing, character-classification, and context-analysis techniques for hand-printed text, such as computer coding sheets in the FORTRAN language. Both edge-detection and topological preprocessing are coupled with classification by a learning machine and used to process a large file of characters printed by a single author. The two systems are combined to achieve a recognition rate considerably better than our previous results. Author (TAB)

N68-20857 Illinois Univ., Urbana.
ON THE DESIGN AND TESTING OF SELF-DIAGNOSABLE COMPUTERS
Ralph Allan Marlett (Ph.D. Thesis) 1966 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6670

A new approach for deriving self-diagnosis programs for digital computers is investigated. The derivation procedure is based on only microorder description of the computer to be tested. The detailed logic information is not needed. This approach is made possible by "standardizing" computer realization techniques by means

of a set of design principles. This thesis describes such a set of design principles which guarantees the existence of a relationship between the behavior of a computer under a large number of failures and alterations of the microorder specification for that computer. The microorder "alterations" are then used to characterize a computer under failure for every machine instruction so that test programs can be written which check for over 93 percent of all failures. Such programs check for "symptoms of failure" rather than the actual component which caused the failure. This procedure can be programmed so that diagnostic programs can be generated by a computer. Dissert. Abstr.

N68-20864# Tracor, Inc., Austin, Tex.
SPECIALIZATION OF A SEMIOTIC THEORY Quarterly Report, 1 Jul.–30 Sep. 1967
Eugene D. Pendergraft Feb. 1968 24 p refs
(Contract DAAB07-67-C-0559)
(TRACOR-67-956-U; ECOM-0559-1; QR-1; AD-665440)

The study is concerned with the problem of controlling semiotic, or sign-using, systems that are capable of both deductive and inductive acts. Its primary focus is the problem of shaping a systemic analogue of knowledge and experience to the subject matters of particular environments. A second problem is that of obtaining an appropriate symbiosis between humans and machines capable of symbolizing. The symbols required to communicate about these two kinds of specialization have inport for this inquiry. Author (TAB)

N68-20867# University of Southern Calif., Los Angeles. Dept. of Psychology.
COMPUTER PERSONNEL SELECTION AND CRITERION DEVELOPMENT: 5. PREDICTORS OF SUCCESS IN PROGRAMMER TRAINING
Joseph W. Rigney Jan. 1968 71 p refs
(Contract Nonr-228(22))
(TR-54; AD-665309)

The study is concerned with the prediction of success in programmer training. Data were collected on trainees in 29 classes at a Navy programmer school. Five types of predictors were studied: tests of separate aptitudes thought to be related to programming, a simulated programming test, a mathematics achievement test, an interest inventory, and a biographical information blank. The predictors were validated against midterm grades, which were based on class work and examinations, and against final grades, which were largely determined by performance in writing a program. Analysis of a preliminary battery of 17 aptitude tests revealed four tests that appeared to have sufficiently high correlations with the criteria to warrant individual or combined use in selection. In the analysis of a final battery of seven tests, the simulated programming test had high correlations with midterm grade and final grade. Multiple correlations of a combination of all tests with the criterion measures were only slightly higher than the correlations using the simulated programming test alone. Analysis of biographical information yielded several variables that could be used as positive indicators of programming potential. A selection strategy is proposed for effective use of background information and tests in making selection decisions. Expectancy charts showing the chances of success in training associated with different test scores are given as part of the selection strategy. Author (TAB)

N68-20932# Montana State Coll., Bozeman. Engineering Research Labs.
A CELLULAR COMPUTER ORGANIZATION FOR MATRIX OPERATIONS
Robert C. Minnick and Lynn E. Cannon 29 Sep. 1967 12 p ref
(Contract N00014-67-C-0477)
(AD-665332)

The discrete Kalman filter appears to be a natural form for realization in a specially organized cellular computer. A large number of vector and matrix operations is required, suggesting that efficiency in such operations is a key factor in overall machine function. This paper presents a possible structure for a vector and matrix operations subsection of such a computer and illustrates specifically matrix multiplication based on an algorithm devised by the author. Author (TAB)

N68-20973*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
DESIGN AND DEVELOPMENT OF A MULTI-LAYER MEMORY SYSTEM Final Report, 28 Jan. 1966–27 Jan. 1967
F. L. Grismore, L. H. Glassman, R. P. Woodward, and M. D. Carithers 27 Jan. 1967 252 p refs
(Contract NAS8-20577; Proj. A-919)
(NASA-CR-61702) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A program designed to determine the feasibility of completely integrating a small magnetic memory on a single substrate is reported. The ultimate goal is envisioned as a substrate of silicon with the complete complement of electronic circuitry formed by diffusion processing around the outer periphery. The program effort was divided into the following four major areas: system design and analysis, keeper development, circuit design and analysis, and memory array fabrication. Results of these studies indicate that the proposed thin film memory system is feasible. A detailed system analysis showed that word drive current requirements will be approximately 150 ma and sense signals at the array terminals of 3 mv can be expected. To eliminate demagnetizing effects and increase drive line efficiency, a ferrite keeper material was developed which provides a relative permeability of nearly 10 over a wide frequency range. The material also possesses the mechanical compliance necessary to permit it to conform to all surface variations thus providing high efficiency flux closure. Because of an adherence problem at one interface in the 10 layer film array structure, an operable memory system was not achieved; however, it is surmised that this problem can be solved with additional time. As a result of work done under the fabrication effort, a compatible material system was evolved and detailed process techniques were developed. Significant among these was the development of a new evaporation source to deposit thick SiO insulating layers at high rates and free of high stress regions near conductor edges. S.C.W.

N68-20975# Elliott Bros., Ltd., London (England). Space and Guided Weapons Div.
INVESTIGATION OF THE SUITABILITY OF THE ELLIOTT MCS 920-M DIGITAL COMPUTER FOR THE NAVIGATION AND GUIDANCE OF THE ELDO SATELLITE LAUNCH VEHICLE
[1967] 63 p ref
(Contract KM/3C/2034/CB.21(d)) CFSTI: HC $3.00/MF $0.65

A study which established that the Elliott MCS 920M digital computer having a fixed point 18 bit wordlength can be programmed to provide navigation data and guidance demands for accurate inertial guidance of the ELDO launch vehicle into a near earth orbit, is reported. The navigation equations which determine velocity and position from the measured acceleration were programmed for an MCS 920A and an Elliott 503. Ten different acceleration profiles were injected into these programs and the corresponding trajectories were compared and found to agree to the accuracy of one least significant bit of the 920 word; the scaling chosen was 1 bit velocity = 5/64 m/sec and 1 bit position = 51.2 meters. A linearized guidance law was programmed for the 920 together with the navigation equations and a simple model of the 2nd and 3rd stages of the ELDO vehicle. It was found that much better results were obtained when this guidance law was evaluated in polar coordinates rather than in cartesian coordinates. A French explicit guidance law was programmed on the 920, and for a series of points on a trajectory the steering signals generated by the 920 were compared with those derived using an IBM computer.

The two sets of results were close and although some divergence was noticeable at the end of the second flight, this divergence was no small that it is not expected to cause significant injection errors. S.C.W.

N68-21000# Chicago Univ., Ill. Inst. for Computer Research.
ICR QUARTERLY REPORT, NUMBER 14
Victor H. Yngve 1 Aug. 1967 39 p refs
(Contract AT(11-1)-614)
(COO-614-57) CFSTI: HC $3.00/MF $0.65

Developments in Maniac III engineering activity and the Man–Machine project are outlined. An investigation of a graph stimulator computer is described. Also, a bench mark calculation for retrieval by confluence of binary attributes in a random-access computer is considered, and numerical stability in n-body integrations is discussed. NSA

N68-21082# California Univ., Berkeley. Lawrence Radiation Lab.
COMPUTER DATA LINK FOR HIGH ENERGY PHYSICS EXPERIMENTS
Sypko W. Andreae 6 Nov. 1967 9 p Presented at the Fall Digital Equipment Computer Users' Soc. Symp., Anaheim, Calif., 10–11 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17918; CONF-671123-1) CFSTI: HC $3.00/MF $0.65

Small computers are used on-line with high-energy physics experiments. When the experimenter desires to estimate the relative value of the experimental data, the necessary analysis can only be performed on a large computer. Hence the need arose for a fast two-way data link between one or more small computers and a large computer. The lack of interrupt facilities in the available large computer and the necessity of using twisted-pair telephone lines both posed unusual design problems. The main components of the data link are interfaces for the two computers, a buffering and error-correcting system, and a transceiver system using 1-mile-long telephone lines. A unique demand and response system both maintains synchronization and supports a highly accurate error-correction system. Control words communicate word count, transfer direction, etc., between the computer programs. Special high-reliability pulse-train signals transmit critical information, such as error and end of record between the interfaces. Author (NSA)

N68-21095# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CALCOMP PLOTTING OF X-RAY POLE FIGURES
Gordon R. Love Jan. 1968 39 p
(Contract W-7405-ENG-26)
(ORNL-TM-2018) CFSTI: HC $3.00/MF $0.65

A FORTRAN 63 program, POLE, used with the CDC 1604 computer is described which converts X-ray intensity data from a serial string of numerical values to a contour map, in stereographic projection, with intensity as a function of angular coordinates relative to the specimen. NSA

N68-21117 Stanford Univ., Calif. Dept. of Computer Science.
A COMPUTER SYSTEM FOR TRANSFORMATIONAL GRAMMAR
Joyce Friedman Jan. 1968 34 p refs
(Contract F19628-67-C-0035)
(CS-84; AF-21; AD-665827)

A comprehensive system for transformational grammar was designed and is being implemented on the IBM 360/67 computer. The system deals with the transformational model of syntax, along the lines of Chomskys Aspects of the Theory of Syntax. The major innovations include a full and formal description of the syntax of a transformational grammar, a directed random phrase structure generator, a lexical insertion algorithm, and a simple problem-oriented programming language in which the algorithm for application of transformations can be expressed. The paper presents the system as a whole, first discussing the philosophy underlying the development of the system, then outlining the system and discussing its more important special features. References are given to papers which consider particular aspects of the system in detail. Author (TAB)

N68-21161# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS NUMBER 14
Wade B. Holland, ed. Feb. 1968 97 p refs
(P-3600/14; AD-665835)

Recent Soviet advancements in cybernetics and computer applications are discussed. The articles are concerned with a ferrite-diode control computer for automatic tracking systems, delays in mathematic economics research, the equipment and organization of the Latvia University Computer Center, future applications of computers, statistics on Soviet scientific organizations and personnel, the use of cybernetics in military control and tactics, the design and shortcomings of the Okean computer for oceanographic studies, and the effectiveness and implementation of programmed instruction. Also included are a bibliography and an annotated list of Soviet newspaper articles and photographs dealing with cybernetics and computer technology. R.N.A.

N68-21174# Los Alamos Scientific Lab., N. Mex.
WIREX, A FORTRAN COMPUTER PROGRAM FOR PRODUCING WIRE LISTS
K. H. Duerre and J. R. Case 27 Dec. 1967 38 p refs
(Contract W-7405-ENG-36)
(LA-3807) CFSTI: HC $3.00/MF $0.65

WIREX is an IBM 7090 computer program that produces wiring lists containing all the information normally found on detailed wiring drawings. Input to WIREX is simple, and output is in the form of a job book containing information in the order in which it is required for an electrician to proceed logically through a wiring job. Code listings, flow diagrams, and a sample problem are included in this report. Author (NSA)

N68-21223 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Foreign Scientific and Technical Literature
Boris Doncov Apr. 1968 29 p refs
(ATD-68-18-87-2; Rept.-12)

Abstracted data are presented on several developments in computer technology reported in Soviet literature. In the area of components, attention is called to an article describing a monolithic, silicon, rectangular diode matrix which may be used for code conversion and decoding. Information on a static tunnel diode flip–flop with redundancy is included. Design data are given on a logic machine for controlling manufacturing processes, an amplitude analyzer for statistical processing of random signals, information storage stability in memories using continuous thin ferromagnetic films, and the magnetic main memory of a digital computer system. Brief descriptions are provided on the M-54 general purpose, transistorized digital computer whose speed is only 16,000 opns/sec, but whose floor space requirement (excluding peripheral equipment) is only 5 m^2, and on the M-1000, M-2000, and M-3000 computers for industrial planning and production control. The first serially produced hybrid computer, using M-220 digital and MN-18 analog computers, is also discussed. Statistical data on the performance of earlier computers are reviewed. M.G.J.

N68-21224*# Arizona Univ., Tucson.
THE DESIGN OF A NEW SOLID STATE ELECTRONIC ITERATIVE DIFFERENTIAL ANALYZER MAKING MAXIMUM USE OF INTEGRATED CIRCUITS
Brian Kendall Conant (Ph.D. Thesis) 1968 173 p refs
(Grant NsG-646; NSF GY-379)
(NASA-CR-94088) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The APE II system, a new hybrid computer for laboratory instruction, served as a test vehicle for new shielding and packaging techniques and the use of current-mode integrated-circuit logic for digital control of computer operations in the design of a third generation high speed interative differential analyzer system. LOCUST, an all-solid-state interative differential analyzer employs ±10-V, 30-mA amplifiers with 30 MHz unity-gain bandwidth and can operate at iteration rates as high as 2,000 analog computer runs per second as well as in real time. Computing elements are plugged directly into the rear of a modified inexpensive patchbay which has removable patchboards. Subroutines are controlled by a flexible digital control unit as well as by patched digital logic or by an associated digital computer. New linear and digital monolithic integrated circuits along with a novel patchbay shielding system and computing-element packaging techniques have enhanced computer performance and reduced costs. This description of the LOCUST system includes performance data, circuit diagrams, examples of applications and an instruction manual. Author

N68-21317*# Sperry Rand Corp., Blue Bell, Pa. UNIVAC Div.
RELIABLE MINIATURE SPACEBORNE MEMORY Final Report
Oct. 1967 62 p
(Contract NAS5-9518)
(NASA-CR-93978) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A magnetic, thin film, plated-wire memory was developed for spaceborne use at temperatures between 25 and 60°C. This breadboard model has a storage capacity of 1,216,512 bits and a speed of 200 kc serial bit rate. It is a nondestructive readout, serial addressed buffer memory. Details are included for the plated-wire memory element and memory system organization, memory packaging and circuitry, circuits and logic, and memory exerciser instructions and logic. M.W.R.

N68-21329# Michigan Univ., Ann Arbor. Dept. of Psychology.
THEORETICAL FRAMEWORKS FOR PATTERN RECOGNITION PROBLEMS Final Report
Wilson P. Tanner, Jr. Jun. 1967 10 p refs
(Grant AF-AFOSR-367-66)
(Rept.-07931-1-F; AFOSR-68-0457; AD-666473)

This report summarizes several studies conducted on pattern recognition problems. One of these involved two problems of parametric statistics with a view to their application to nonsupervised pattern recognition. Another examined the question of the least costly word equivalent to a given word in the case in semigroups in which the equivalence relation is a two-sided congruence relation. A third continues a study of current flow in the central nervous system. The quantitative relationship between the parameter of stimulus current intensity and the anatomical characteristics of certain neural elements in the nervous system was examined. Author (TAB)

N68-21390 Illinois Univ., Urbana. Dept. of Computer Science.
LINEAR PROGRAMMING IMPLEMENTATION IN ILLIAC 4. 2: SOME SURVEY ON LP AND DESCRIPTIONS ON PRODUCT FORM REVISED SIMPLEX METHOD
Frank T. Chen 31 Oct. 1967 17 p refs
(ILLIAC-4-163)

A general statement of the linear programming problem is given. Various methods for solving the linear programming problem are categorized and mentioned, especially, the gradient projection method, which is mathematically explained. Some experimental results, which appeared in various literature, are compared and discussed. A product form revised simplex method is recommended for implementation of large scale linear programming problems in ILLIAC IV. Mathematical description for this algorithm is presented in a brief and concise form so that the whole computational procedure will be understood without involving too much mathematical operation. Different methods for improving the pivot selection such that a greater change of objective function will be achieved are described and a flow chart is provided. Finally, the method of data indexing for this product form revised simplex method is proposed and comparison with other schemes is made. General way of data storage in core for a current processing and computational procedures for this method are presented. Author

N68-21425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTION OF BINARY-DECIMAL CODES FOR AUTOMATIC DIGITAL MEASURING INSTRUMEN S (ADMI) WITH A TERNARY COMPARISON DEVICE [VYBOR DVOICHNO-DESYATICHNOGO KODA DLYA AVTOMATICHESKIKH TSIFROVYKH IZMERITEL'NYKH PRIOROV (ATSIP) S TORICHNYM USTROYSTVOM STRAVNENIYA]
V. V. Yefimenko 29 Aug. 1967 18 p refs Transl. into ENGLISH from an SSSR Sibirsk. Otd. Avtometriya (USSR), no. 5, 1965 p 50–57
(FTD-HT-67-150; AD-666094)

This article is a discussion of the selection of a binary-decimal code which is optimal with respect to speed for automatic digital measuring instruments using ternary comparison devices. It is shown that for the purpose of more effective use of the functional possibilities of such comparison devices it is desirable that the digital coding be done parallel in two channels. TAB

N68-21470# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS TECHNOLOGY: 10. BIBLIOGRAPHY OF LITERATURE CITED IN 1964 ISSUES OF THE "JOURNAL OF ABSTRACTS—CYBERNETICS"
Wade B. Holland, ed. Feb. 1968 302 p refs
(Contract F44620-67-C-0045)
(RM-5587-PR; AD-666020)

This Memorandum is a bibliography of all Soviet work in cybernetics and related fields abstracted in 1964 issues of the Russian Journal of Abstracts–Cybernetics (Referativnyi zhurnal–Kibernetika). All entries for the Bibliography have been translated into English and automatically printed out in author-order from a computer-sorted file of data. Author (TAB)

N68-21499*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAMS FOR PLANE COLLISIONLESS SHEATHS BETWEEN FIELD-MODIFIED EMITTER AND THERMALLY IONIZED PLASMA EXEMPLIFIED BY CESIUM
Susan L. Button and James F. Morris Washington Apr. 1968 70 p refs
(NASA-TM-X-1562) CFSTI: $3.00 CSCL 20I

Two computer programs coded in FORTRAN IV are described for plane collisionless positive-ion and electron emission sheaths. Given the emitter temperature, emitter work function, atomic ionization potential, plasma electron and ion number density, and plasma electron, ion, and atom temperatures, the programs compute current densities, potential drop through the sheath, charge density, electron field, and sheath distance. Author

N68-21514# Wisconsin Univ., Madison. Mathematics Research Center.
INTERVAL ARITHMETIC PACKAGE (INTERVAL) FOR THE CDC 1604 AND CDC 3600
Allen Reiter Jan. 1968 70 p
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-794; AD-666186)

The practical implementation of the techniques of interval analysis developed by professor R. E. Moore (Interval Analysis, Prentice-Hall, 1966) requires computer hardware or software for the performance of the operations of interval arithmetic. This report describes a program written for the CDC 1604 and later adapted to the CDC 3600 which allows the user to incorporate interval arithmetic in programs written in Fortran. Author (TAB)

N68-21520# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS NUMBER 13
Wade B. Holland, ed. Jan. 1968 75 p refs
(P-3600/13; AD-665103) CFSTI: HC$3.00/MF$0.65

Contents: Cybernetics in the 21st century; Ural-2 movie-film input unit (photo); State Committee on Science and Technology; Economic reforms in Rudnevs ministry; Interview with Rudnev; Dnepr-2; Dnepr-2 control computer complex; Penza computer factory; Ural-11, -14; Programmed teaching; definition, philosophy; M-20/Ural-4 complex; Machine operating efficiency, costs; Third-generation work at Minsk factory; Management science coordination needed; Need for small computers; ATE-80; Press review, December 1967. TAB

N68-21532# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PERMANENT STORAGE ON METALLIC CARDS [DOLGOVREMENNAYA PAMYAT' NA METALLICHESKIKH KARTAKH]
A. V. Petrov and V. I. Vinogradov 20 Sep. 1967 19 p refs Transl. into ENGLISH from Mosk. Vvssheve Tekh. Uchilishche Mkh. (Moscow), no. 5, 1966 p 38–50
(FTD-MT-24-284-67; AD-666487)

A description of one type of permanent storage memory unit using metallic cards. Interest has been created in this system because of high speed in operation, high work reliability, long service life, simplicity of preparation, small dimensions, and low cost. The working principle of such a unit is based on the phenomenon of electromagnetic induction. Material for the punched cards can be thin metallic copper, duralumin, or brass foil. Various dimensions for the cards are possible but for the sake of adapting them to other items of standard equipment for punching and sorting it was found expedient to make the dimensions those of a standard paper punched card with 45 columns and rectangular punches 3.2 x 6.35 mm. Construction, operation, and circuitry of such a memory unit is described in detail. Author (TAB)

N68-21554# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE COMPLEX FOR INPUT OF DATA INTO A SPECIALIZED DIGITAL COMPUTER FOR STATISTICAL INVESTIGATIONS [KOMPLEKS USTROYSTVA VVODA DANNYKH V SPETSIALIZIROVANNUYU TSVM DLYA STATISTICHESKIKH ISSLEDOVANIY]
B. D. Borisov, Ye. N. Karyshev, and Z. I. Nesterova 4 Oct. 1967 12 p refs Transl. into ENGLISH from Akad. Nauk SSSR Sibirsk. Otd. Inst. Avtomatiki i Elektrometrii (USSR), v. 1, 1965 p 153–157
(FTD-MT-24-286-67; AD-666489)

The article presents a verbal description and block diagrams of adaptable devices for conversion of data in graphic form on paper tape or in pulse form on magnetic tape into binary digital form for input into digital computers. A photodiode read-in device and vidicon read-in camera are described. TAB

N68-21583# Mitre Corp., Bedford, Mass.
THE PERFORMANCE OF A SIMULATED CONVOLUTIONAL DECODER ON MEASURED HF AND TROPOSPHERIC DATA CHANNELS
Kenneth Brayer Jan. 1968 45 p refs
(Contract AF 19(628)-5165)
(MTR-528; ESD-TR-67-423; AD-666024)

A Massey diffuse convolutional decoder was simulated in the IBM 7030 computer and used to decode binary digital error patterns measured at 2400 bits/sec on an HF radio circuit and on a multiple link data circuit dominated by a tropospheric scatter path. It was found that the simulation performed at least as well as previous cyclic code simulations on HF radio and better than cyclic codes on the tropospheric path. Author (TAB)

N68-21593*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A NINETEEN-CHANNEL FILTER BANK SPECTRUM ANALYZER FOR A SPEECH RECOGNITION SYSTEM
Kenneth N. Stevens and Gottfried von Bismarck 5 Jul. 1967 26 p refs
(Contract NAS12-138)
(NASA-CR-86046; SR-2) CFSTI: HC$3.00/MF$0.65 CSCL 09B

Details are given on the input system of a computer which will be capable of adapting to the voice characteristics of an individual. The input system is a band of filters which span that part of the audio frequency range significant in speech. The detail design of this filter bank is presented, and the critia which led to the selection of the frequency and time domain characteristics of the spectrum analyzer. Considerations which governed the selection of center frequencies and bandwidths for the bandpass filters are delineated, and the frequency response of the bandfilters is discussed. The input stage of the spectrum analyzer, which contains an input amplifier, a pre-emphasis network, and two input amplifiers feeding the bandpass filters, is also analyzed. Diagrams are given to show the circuitry of the input stage, rectifiers, and low-pass filters. B.S.D.

N68-21600# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PUNCHED CARD READER [USTROYSTVO VVODA S PERFOKART]
V. M. Bubel and S. K. Kosobutskiy 10 Oct. 1967 10 p Transl. into ENGLISH from Akad. Nauk BSSR. Inst. Tekhn. Kibernetiki (Minsk), 1965 p 159–163
(FTD-MT-24-287-67; AD-666152)

This paper deals with a new type of on-line punched card reader designed to feed data into the punched tape input terminal of the Minsk-1 computer. The card reader extends the capability of this computer by providing an additional means of input. Standard 45-column cards are used at a speed of 100 cards per minute. The information is read in a series-parallel mode. An internal decoder converts the decimal data into 8-4-2-1 BCD code, compatible with the particular input terminal of the computer. The computer generates appropriate control signals utilized in the control module of the reader. A signal is fed into the computer whenever a word begins or ends. For the serial output of the digits, a shift register is used consisting of transistor-ferrite core elements. A laboratory model was built and tested with satisfactory results. The unit is small, simple, and reliable. Author (TAB)

N68-21601# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE KIEV COMPUTER, DESIGN AND USE
L. N. Dashevskiy, S. B. Pogrebinskiy, and Ye. A. Shkabara 12 Jul. 1967 328 p refs Transl. into ENGLISH of the publ. "Vychislitel'naya Mashina Kiyev, Proyektirovaniye i Ekspluatatsiya" Kiev, Izd. Tekhn., 1964 p 1–324
(FTD-MT-65-592; AD-666095)

This book collected the experience in the design and use of the asynchrous universal digital computer Kiev. The principles of its construction and structure circuitry, the method of performing control and arithmetic operations, and the schematics of the elements, components, and basic units of the computer are described. The book includes the methods of calculating and investigating the reliability of a digital computer and problems of organizing the use of large electronic digital computers. The book is intended for engineers, researchers, students and graduate students in the field of computer technology and cybernetics and also for specialists interested in the development and use of computer and control equipment. TAB

N68-21612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYSTEM OF AUTOMATIC INPUT OF GRAPHIC INFORMATION INTO COMPUTERS AND AUTOMATIC READERS. EXPERIENCE IN DEVELOPMENT AND OPERATION [SISTEMA AVTOMATICHESKOGO VVODA GRAFICHESKOY INFORMATSII V ETSVM I CHITAYUSH-CHIYE AVTOMATY]

V. Oborotov, Y. Romanov, Yu. Sidorin, and M. Fiks 14 Jul. 1967 12 p Transl. into ENGLISH from the publ. "Avtomatizatsiya Vvoda Pis'mennykh Znakov v Elektronnyye Vychislitel'nyye Mashiny" p 90–95 Presented at Nauchn.-Tekhn. Soveshch., Vil'nius, 17–20 Nov. 1965

(FTD-HT-23-782-67; AD-666085)

A block diagram of the device is presented. The white level is stabilized in the automatic reader by autocompensation of the uneven signal from the white background of the sheet along a line. The time required for reading one character is not over 5 msec, which is equivalent to a rate of 200 characters per second for a sheet with densely printed text. The mechanical portion of the device provides for feeding, transporting and removal of blanks from a packet of 50-70 sheets stored in the loading casette of the machine. The transfer device for information input from the automatic reader to the computer is made of standard units of the Ural-4 computer and is in the form of a separate unit. After preliminary preparation data input is controlled directly from the control panel of the reader. Author (TAB)

N68-21626# Analysis and Computer Systems, Inc., Burlington, Mass.

DEVELOPMENT OF NON-NUMERIC SYSTEMS AND DATA REDUCTION IN SUPPORT OF AIR FORCE CAMBRIDGE RESEARCH LABORATORIES SCIENTIFIC RESEARCH Annual Scientific Report

Donald J. Armstrong, Ruth A. Birtwell, William A. Delaney, David Navisky, and Henry J. Noble Sep. 1967 138 p refs

(Contract AF 19(628)-6144)

(SR-1; AFCRL-67-0692; AD-666062)

The report is the first of three annual scientific reports to record the status and progress of Scientific Analytical Investigations, the preparation of computer programs, Data Reduction, and the development of Non-Numeric Systems in support of Environmental research and pertinent aspects of the physical sciences. During the year covered by this report, the 79 completed programs ranged in complexity and size from conversion of programs from one language or computer system to another, up to analysis and development of a large system of programs. Author (TAB)

N68-21655# Lockheed-California Co., Burbank.

KEYBOARD TRANSMITTER, TELETYPEWRITER TT-568/AGC-6 Interim Engineering Report, 25 Aug.–25 Nov. 1967

Carlyle Smith 25 Jan. 1968 16 p Prepared in cooperation with Natl. Cash Register Co., Dayton, Ohio

(Contract NOw(A)-66-0039-f)

(IER-3; AD-666573)

The fabrication of the Qualification Test Unit of the Keyboard-Transmitter, Teletypewriter TT-568/AGC-6 was completed. An unqualified preproduction unit was delivered to Lockheed prior to completion of Qualification Testing. Author (TAB)

N68-21673# General Electric Co., New York. Research and Development Center.

METHODS AND COMPUTER PROGRAM FOR ESTIMATING PARAMETERS OF SEVERAL NORMAL POPULATIONS FROM CENSORED DATA

G. J. Hahn and J. M. Miller Dec. 1967 76 p refs

(Rept.-67-C-472)

Data are said to be censored if the values of all observation outside some known or randomly-obtained limits are unknown, but the number of such samples is known. This report develops procedures based on the method of maximum likelihood, and describes and illustrates the use of a FORTRAN computer program for estimating the means and (common) standard deviation of up to 15 normal populations, for estimating the asymptotic variances and covariances of the resulting estimates, and for obtaining various other useful quantities from censored data. The results are applicable both for one-sided and two-sided censoring and hold both for the case where the censoring point is known (Type I censoring) and that where the number of samples to be censored at each tail of the distribution is known (Type II censoring). A review of the literature pertaining to estimation from a single normal population, of which the present results are a generalization, is also included. Author

N68-21688# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

HUMAN FACTORS AND THE DESIGN OF TIME SHARING COMPUTER SYSTEMS

R. S. Nickerson, J. I. Elkind, and J. R. Carbonell 15 Nov. 1967 24 p refs

(Contract F19628-68-C-0125; ARPA Order 627)

(BBN-1570; AFCRL-68-0054; SR-2; AD-666443)

The advent of computer time sharing poses an extraordinary challenge to human factors research during the next decade. Before time sharing, two facts combined to de-emphasize the importance of human factors considerations in the design of computer systems: (1) the cost of the computers time was exorbitantly high relative to the cost of users time, and (2) the users constituted a select, highly skilled and highly motivated group of specialists. Two of the promises of time sharing, however, are (1) a drastic reduction in the cost of computer time to the individual user, and (2) the large scale availability of computer facilities to individuals untrained in any areas of computer technology. Human factors considerations then become important both for economic and psychological reasons. This paper briefly notes what a few of these considerations are. Author (TAB)

N68-21762# Illinois Univ., Urbana. Dept. of Computer Science.

ILLIAC 4 Quarterly Progress Report, Jul.–Sep. 1967

Dec. 1967 26 p refs

(Contract AF 30(602)-4144)

(AD-665916)

Hardware, software, and applications research for the ILLIAC 4 computer are summarized. Reliability analysis, program supplementation, and control unit and input/output system design are reported for the hardware portion. Language translator writing system efforts involve the symbol scanner, syntax, semantics, and an intermediate language; and Tranquil and ILLIAC 4 similator software efforts are also mentioned. Applications research deals with partial differential equations, including the alternating direction implicit, Carlson's, and slip flow methods. Phased array radar signal processing is discussed, as are iteration and eigenvalue problem matrices, linear programming, and computer graphics. The latter mentions a timing study, a computer mapping algorithm, and a graphical display programming system. Codes for Tranquil, non-numerical applications, and a population genetic program are also mentioned. M.W.R.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-20632 California Univ., Berkeley.
DESIGN AUTOMATION: ON LINE METHODS
Joseph C. Sharp (Ph.D. Thesis) 1966 310 p
Available from Univ. Microfilms: HC $13.95/MF $4.00 Order No. 67-5168

This work discusses two aspects of the physical realization of electronic systems, the placement of elements and the assignment of their interconnecting wiring. It presents a new criterion to guide and evaluate this process. The criterion, called the System Delay, is the duration of the longest transient which may occur in the system. An algorithm is suitable for use on computers and permits on-line interaction. It is explained in set notation, illustrated by a detailed calculation and described in detail by a fully documented program. The solution of a variant of the classical thirty-four element problem by the "SD Algorithm" is presented and compared with previous work. It is concluded that the new criterion is useful in practical problems, and that it opens a new area for further study. Dissert. Abstr.

N68-20714# Stanford Research Inst., Menlo Park, Calif.
HIGH-INFORMATION-DENSITY STORAGE SURFACES Quarterly Report, 1 Jul.–30 Sep. 1967
K. T. Rogers and J. Kelly Feb. 1968 28 p refs
(Contract DA-28-043-AMC-01261(E))
(ECOM-01261-10; QR-10; AD-665634)

The program is devoted to the preparation and investigation of two novel kinds of electron-beam-addressable storage elements of submicron size and densely packed arrays of these elements. One such element, called a micro-cap, consists of an isolated microcapacitor at the bottom of a hole in a metal/dielectric/metal film sandwich. The other element, called a micro-ring, consists of an isolated metal film ring embedded concentrically with a hole in the dielectric of a multilayer metal/dielectric film sandwich. During this quarter, storage and readout data on micro-cap elements were taken at high beam energies (around and above the upper unity-crossover energy for secondary-electron emission and up to the bombardment-induced conductivity energy) for data storage. Beam measurements are reported on the mildly bakeable (400 degrees C) field emitter and molybdenum lens system in its commercial ultra-high-vacuum system. Work on storage structures is being concentrated on attempts to make regular arrays with a commercial electron probe. Progress on the use of this instrument and on the steps of etching subsequent to the line-ruling is reported. Author (TAB)

N68-20792 Iowa State Univ. of Science and Technology, Ames.
NOISE IN THIN MAGNETIC FILM PARAMETRIC AMPLIFIERS FROM 78°K TO 300°K
Charles Teh-chuan Chen (Ph.D. Thesis) 1966 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5573

The purpose of this investigation was to evaluate and analyze the noise performance of thin magnetic films in a parametric amplifier operating over an extended temperature range (78°K to 300°K). The inverting type parametric amplifiers were analyzed and developed. The noise performance of a properly designed thin magnetic film parametric amplifier is a function of the ratio of the signal frequency and the idler frequency as well as the dynamic quality factors of the thin film inductor at the signal and the idler frequencies. The circuit analysis also showed that the noise performance of the thin magnetic film parametric amplifier could be improved by cooling the parametric element. The measured noise figures for many test amplifiers at the room temperature agreed quite well with the calculated value when the bias field was above twice the H_k of the film and the pump field was about five times the value of H_k. Dissert. Abstr.

N68-20827*# Martin Co., Denver, Colo.
ADDRESSABLE TIME DIVISION MULTIPLEXER SYSTEM CABLE AND CONNECTOR STUDY EMI STUDY Final Report
R. Loveland and J. Goodwin Mar. 1968 37 p refs Suppl.
(Contract NAS8-21176)
(NASA-CR-61686; MCR-67-425, Sup.) CSCL 09A

Four types of cables were selected and tested in a representative multiplexer system so that the cables could be compared in actual performance. The final report pointed out, however, that the tests only compared the cables in a relatively low noise environment, which is not necessarily the real environment. This report is intended to provide designers of multiplexer systems a better working knowledge of the shielding effectiveness of several cable types. This report compares shielding effectiveness and the effect on EMI of various system grounding arrangements. The information is presented in a manner directly relating it to a multiplexer system. Author

N68-20837# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
DEVELOPMENT, FABRICATION, ASSEMBLY, AND TESTING OF BIAXIAL POINTING CONTROL AND ASSOCIATED TELEMETERING SYSTEMS Final Report, 1 Mar. 1963–15 Jun. 1967
Vernon L. Stone, Frank E. Wise, and Martin Cunningham Nov. 1967 80 p
(Contract AF 19(628)-2911)
(AFCRL-67-0646; AD-665897)

The development of the solar biaxial and lunar biaxial pointing controls was begun in 1947. The contract being reported upon is the sixth in the series for the Air Force Cambridge Research Laboratories; these units are also being used by the Naval Research Laboratory and the National Aeronautics and Space Administration. This project involves the work being done on both lunar and solar biaxial pointing controls. Author (TAB)

N68-20883# Microwave Electronics Corp., Palo Alto, Calif.
INVESTIGATIONS OF BROADBAND FERROMAGNETIC POWER LIMITERS AND EXPANDERS AS DUPLEXING ELEMENTS FOR MICROWAVE SYSTEMS Final Report, 1 Jun. 1966–30 Oct. 1967
Peter Young and F. A. Olson Feb. 1968 38 p refs
(Contract DA-28-043-AMC-02120(E))
(ECOM-02120-F; AD-665521)

Efficient, broadband coupling to the lowest order surface magnetostatic mode has been demonstrated experimentally. An S-band limiter with over 600 MHz bandwidth and 2 to 4 db insertion loss has been built. The limiting threshold varies from 20 to 40 mW, with dynamic range bettter than 20 db throughout the band. An S-band helix expander has been fabricated. Its maximum high level insertion loss is not more than 1.5 db. A C-band subsidiary resonance limiter having limiting threshold of about 50 mW has been built. Author (TAB)

N68-20968 Bhabha Atomic Research Centre, Bombay (India).
A CURRENT INTEGRATOR FOR USE WITH LOW VARIABLE CURRENTS
S. K. Gupta 1967 10 p refs
(BARC-310) CFSTI: HC $3.00/MF $0.65

A transistorized current integrator using a very high input impedance has been designed. It is found to be linear in the range 1 nA to 10 μA. The leakage has been reduced to $\approx 5\times10^{-12}$ amps and reproducibility of the calibration is less than ±0.3%. Author

N68-21013# Zenith Radio Research Corp., Menlo Park, Calif.
TRANSVERSE-WAVE HIGH-POWER TUBE Quarterly Report, 1 Jul.–30 Sep. 1967

C. Burton Crumly and Roy A. Larsen Jan. 1968 12 p
(Contract DAAB07-67-C-0226)
(Rept.-8; ECOM-0226-3; QR-3; AD-665381)

Research and development work is described on a traveling-wave power amplifier tube employing transverse-wave interaction between the negative synchronous wave and a circuit wave on a balanced structure. The theoretical advantage in this arrangement is the possibility of high-power amplification with high overall efficiency, due to the lack of longitudinal or transverse velocity modulation in the spent beam. Final assembly of the first tube is described along with the difficulties encountered. Processing is also described and the tube is shown mounted on the vacuum station. Author (TAB)

N68-21022# Airborne Instruments Lab., Deer Park, N. Y.
RADIO FREQUENCY NONRECIPROCAL DEVICES Final Report
A. Di Nardo, Y. Klinger, and F. Arams Oct. 1967 46 p refs
(Contract DA28-043-AMC-02281(E))
(Rept.-2011-1; ECOM-02281-E-F; AD-665632)

This report covers the design and development of an octave bandwidth radio-frequency isolator. A device has been built which offers 20-db minimum isolation over an octave band, from 7 to 14 MHz, with only 2.5-db insertion loss. 10-db isolation is achieved over a 3 to 1 frequency range. The isolator makes use of Helicon waves in InSb for the nonreciprocal element. These waves have been thoroughly studied, and conditions for their optimum use have been closely met. An RF Helicon circulator is also covered in this report. Author (TAB)

N68-21157# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
A LOGARITHMIC AND PERIOD AMPLIFIER FOR AUTOMATIC CONTROL OF NUCLEAR INSTALLATIONS [UN AMPLIFICATORE LOGARITHMICO E DI PERIOD O PER IL CONTROLLO AUTOMATICO DI IMPIANTI NUCLEARI]
D. Malosti, D. Manzo, and C. Volpe Rinonapoli 1967 46 p refs In ITALIAN; ENGLISH summary
(RT/EL(67)12) CFSTI: HC $3.00/MF $0.65

A period and logarithmic amplifier is here described. The logarithmic element is a planar silicium transistor whose logarithmic characteristics, errors and drift are also analyzed. The experimental characteristic curve is given with a precision within some units per 1000 of one decade for 10^{-11}A to 10^{-4}A input currents and within 2% of one decade for 10^{-4}A to 10^{-3}A. Stability, time of response and output noise of the whole system are then analyzed. The response time is varying in connection with the input signal amplitude in order to be optimized with reference to the noise. Author

N68-21181# General Electric Co., Syracuse, N. Y. Electronics Lab.
FAILURE MECHANISMS OF SOLID-STATE MICROWAVE SOURCES
J. F. Schenck and T. A. Midford Sep. 1967 18 p refs
(R67ELS-71)

Life tests and failure analyses have been conducted on a type of silicon p–n diode that can be used as a source of 10–20 GHz microwaves. For this application the diodes are required to operate far into avalanche breakdown and to dissipate large amounts of heat. When the avalanche current exceeds a critical value the devices are destroyed. The failure mechanism is believed to be a form of second breakdown. Failure occurs within the bulk of passivated planar diodes and at the surface of unpassivated mesa diodes. No significant amount of progressive degradation of the diode characteristic was observed. Author

N68-21202# Siemens-Schuckerwerke A. G., Erlangen (West Germany).
BEHAVIOR OF SILICON NPN TRANSISTORS BY IRRADIATION WITH ELECTRONS AND PROTONS [UNTERSUCHUNG UEBER DIE VERAENDERUNG DER ELEKTRISCHEN KENNDATEN VON SILIZIUM-NPN-TRANSISTOREN DURCH BESTRAHLUNG MIT ELEKTRONEN UND PROTONEN]
R. Baeuerlein, W. Krueger, and D. Uhl Bundesministerium fuer Wiss. Forsch. Oct. 1967 250 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-31) CFSTI: HC $3.00/MF $0.65

Silicon n–p–n transistors were irradiated with electrons of energies of 40 keV, 0.2 MeV, 0.8 MeV and 2 MeV and protons of energies from 2 to 3 MeV. The changes in electrical properties (current gain, reverse currents, break-down voltages) due to defect formation and ionization effects were investigated at different-biased devices. It is shown that the decrease in current gain due to ionization effects are caused by an increase of the surface recombination velocity at the space charge region of the base emitter junction. The radiation damage of these devices in the earth radiation belt is discussed for some typical satellite orbits. Author

N68-21230*# General Precision, Inc., Glendale, Calif. Librascope Group.
STUDY OF COLD-SUBSTRATE DEPOSITION OF THIN FILM PASSIVE ELEMENTS
Donald R. Schoonover Jan. 1968 64 p
(Contract NAS12-561)
(NASA-CR-86044; NASA-DS-12345) CFSTI: HC $3.00/MF $0.65
CSCL 09A

Thin film resistors and capacitors having various material compositions were fabricated on glass substrates and on oxidized silicon substrates using the Librascope cold substrate deposition process. Capacitors of 10^5 pico-farads per square inch deposited on glass substrates met all design goal requirements of tolerance, temperature coefficient, breakdown voltage and high temperature life. Capacitors fabricated on oxidized silicon wafers met all design goals with exception of the specified breakdown voltage, due to pinholes in the thermally oxidized wafer surface. Resistors of 10^3 ohms per square met all design goal requirements of tolerance, temperature coefficient, noise and high temperature life. Resistors having larger sheet resistances (10^4 and 10^5 ohms per square) were reproducibly deposited, but, when subjected to a post-deposition burn-in (to stabilize the films prior to life tests at 350°C), experienced changes in characteristics such that their final values could not be reproducibly achieved within design goal tolerances. Author

N68-21259# General Electric Co., Schenectady, N. Y. Research and Development Center.
SELECTION OF AN INSULATION SYSTEM
K. N. Mathes Sep. 1967 14 p refs
(Rept.-67-C-373)

This report includes a discussion of the relationship between design needs and properties of insulating materials. A discussion of the usefulness of data on insulating materials from several sources is included. It is concluded that it becomes the responsibility of the supplier of materials to provide useful data on insulating materials and recommendations related to the compatibility between materials. It is judged that the manufacturer of electrical equipment must also evaluate materials but must extend his evaluation programs to include the systems of insulation which will be actually used. Some of the problems in this connection and in related standardization are discussed. Author

N68-21281# General Electric Co., Philadelphia, Pa. Missile and Space Div.
80-WAY POWER DIVIDER

C. Woessner 20 Dec. 1967 43 p
(Rept.-67SD361)

The subject of this report is the design of an 80-way stripline power divider with nominal 50-ohm impedance, frequency of operation 4.0 GHz ±5%, minimum 17.5 dB isolation between any two output ports, equal phase output ports ±7° maximum deviation from the mean, and a power loss from input to each output port of 19.65 dB ± 0.85 dB. A photograph, circuit layouts, and test data are included. Author

N68-21316 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
IMPROVED BASE LINE STABILIZATION FOR PULSE AMPLIFIERS
R. Patzelt 1967 18 p refs Submitted for publication
(SGAE-E-9/1967)

The base-line of the output of a dc-coupled pulse amplifier can be held within narrow limits, if a regulator that provides a high degree of negative dc-feedback from the output to the input via a low-pass filter is used. Base-line shifts following a CR-coupling network at the input can be avoided for duty cycles up to 40%, if the regulator-amplifier limits at very low amplitudes. In this case the stabilization circuit reacts not on the arithmetic mean value of the output-signal, but practically, on the undisturbed baseline that can be stabilized. A further improvement using a gate within the feedback-path, that closes during each input pulse is discussed. The circuit is given in detail: coupled with an amplifier with an output range of ± 10 V, the mean value of the baseline is held within ± 2 mV at a pulse rate of 10.000 pps (from a NaI-detector), the statistical fluctuations go up to ± 5 mV. The dc-shift without signal is less than 5 mV/day. Author

N68-21462# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
NETWORKS WITH UNITY-GAIN VOLTAGE AMPLIFIERS
Dan Hilberman Dec. 1967 83 p refs
(Contract AF 19(628)-1699)
(AFCRL-67-0553; SR-19; AD-665147)

This report considers multiterminal common-ground networks of resistors, capacitors, self-inductors, and unity-gain voltage amplifiers (UGAs). When the UGAs are grounded the networks admittance matrix must belong to a particular subclass of the rational matrices. A synthesis procedure is given for realizing any member of this subclass. When the UGAs are not grounded a different procedure realizes any rational matrix as either the admittance or the transfer matrix of an inductorless network. The resistor values used in this procedure are directly related to the coefficients of the matrix elements and the capacitors used can be made to have one common value. Author (TAB)

N68-21471# General Electric Co., Schenectady, N. Y. Research and Development Center.
NEW SOLID STATE DEVICE CONCEPTS Final Report, 1 Apr.–31 Oct. 1967
Manuel Aven, Walter Garwacki, Robert N. Hall, and John R. Richardson Jan. 1968 79 p refs
(Contract AF 19(628)-4976)
(S-68-1001; AFCRL-68-0048; AD-666445)

The report summarizes the ZnSexTe(1-x) light-emitting diode work carried out under the present contract. It includes recent investigations of the thermodynamics of ZnSexTe(1-x) crystal growth which are concerned with the effects of varying the partial pressure of the chalcogen and the donor or acceptor doping. The report also reviews the status of the thin-film GaAs storage diode. The experimental procedures and results are described in some detail. Reproducibility and compatibility with integrated circuitry are satisfactory and make this device attractive for use in memory arrays. Preliminary results on radiation tolerance are also given. Author (TAB)

N68-21502# Aerojet-General Corp., Azusa, Calif. Electronics Div.
DEVELOPMENT OF MICROELECTRIC ELECTRONICALLY TUNED RECEIVER Quarterly Report, 1 Oct. 1967–1 Jan. 1968
Richard A. Russell, D. W. Lewis, and D. C. Brayton 31 Jan. 1968 30 p
(Contract DAAB07-67-C-0600)
(Rept.-1166-01-2; ECOM-0600-2; QR-2; AD-666232)

The final discrete breadboards were constructed and evaluated, the mask layout drawings were completed, and the required semiconductor devices were obtained for the thin-film front-end. Author (TAB)

N68-21506# Stanford Univ., Calif. Systems Techniques Lab.
OPERATION AND MAINTENANCE OF THE ST2015-C S-BAND 200 WATT TWT AMPLIFIER
R. W. McCoy Sep. 1967 54 p
(Contract AF 33(615)-3589)
(SU-SEL-67-079; TR-2015-5; AD-666041)

A 200 W, CW, S-band amplifier was built using an STS-101 traveling-wave tube. The report describes the amplifier system, the ST2015-C, and provides the information necessary to install, operate, and maintain the system. The amplifier provides a minimum of 30 dB small signal gain from 2 to 4 GHz with a minimum CW power output of 200 W (300 W nominal). The system power requirements are 208 V (line to line), three phase, 400 Hz at 15 A per phase and 28 V dc at 2 A. The system is packaged in aircraft-type cases and is suitable for operation in a pressurized aircraft. Author (TAB)

N68-21580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW CIRCUITS FOR FREQUENCY DIVIDERS WITH VARIABLE COEFFICIENTS [NOVYYE SKHEMY DELITELEY CHASTOTY S PEREMENNYM KOEFFITSIYENTOM]
A. P. Zaytsev and A. I. Zaytsev 30 Aug. 1967 11 p ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 2, 1964 p 239–242
(FTD-HT-67-203; AD-666126)

A method of frequency division in which the division ratio depends on a controlling d-c voltage is considered; a storage capacitor counts a certain number of incoming pulses and by discharging through a thyratron creates lower-frequency outgoing pulses. Descriptions of the principal single-phase and 3-phase circuits and oscillograms of laboratory tests are presented. The application of the variable-ratio divider is indicated for shaping and counting schemes as well as for d-c motor pulse-type speed regulation systems. Author (TAB)

N68-21643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POINT DIODES FROM GALLIUM ARSENIDE [TOCHECHNYYE IZ ARSENIDA GALLIYA]
A. P. Vyatkin and A. A. Vilisov 11 Sep. 1967 25 p refs Transl. into ENGLISH from the publ. "Ministerstvo Vysshego i Sprednego Spetsial'nogo Obrazovaniya Rsfsr. Poverkhnostnyye i Kontaktnyye Yavleniya v Poluprovodnikakh" Tomsk, 1964 p 238–253
(FTD-MT-66-90; AD-666150)

The article gives a brief survey of previous literature on the general and rectifying properties of a gallium arsenide-metal point contact. Data are given on the processes of electrical forming applicable to manufacture of rectifiers and tunnel diodes. Results are given for quantitative calculations of electrical forming of a gallium arsenide-metal point contact. The calculations are made for two cases: (1) for the case of spherical symmetry assuming that the point contact has no size, i.e., the contact is represented as a mathematical point; (2) for the case of ellipsoidal symmetry, taking the actual dimensions of the contact between metal and semiconductor into account. TAB

N68-21687# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
STUDIES ON COMPONENTS, CIRCUITS AND TECHNIQUES FOR ELECTRONIC EQUIPMENT INTENDED FOR SPACE APPLICATIONS [UNTERSUCHUNGEN UEBER BAUELEMENTE, SCHALTKREISE UND BAUWEISEN FUER ELEKTRONISCHE GERAETE UNTER RAUMFAHRTBEDINGUNGEN]
P. Mitsch, W. Friedl, G. Fritsch, W. Siegelin, and J. Gluch Bundesministerium fuer Wiss. Forsch. Aug. 1967 130 p refs in GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-22) CFSTI: HC $3.00/MF $0.65

The requirements imposed on, and the results achievable in, the production of tantalum thin film resistors and capacitors are described, and a process is specified for manufacturing sample quantities of resistor networks. For application in analog–digital converters, IC differential amplifiers as well as the selection of multiple components on transistor wafers are discussed. Finally, the production on the trial results, as well as the joining and throughplating processes, of printed circuit boards using different metal foils are described. Author

N68-21787 Ohio State Univ., Columbus.
LOW NOISE ELECTRON GUNS FOR TELEVISION PICKUP TUBES
Richard Mason Campbell (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-6301

The first object of this research was to reduce the longitudinal beam energy spread in the beam from an electron gun of the type used in television pickup tubes. The reduction of this energy spread would allow a smaller total beam current in the tube and hence allow a higher ultimate sensitivity in the pickup tube. It is shown here theoretically and verified by experiment that the longitudinal beam energy spread decreases as the linear beam magnification is increased in the typical crossover gun used in pickup tubes. This increase in the beam magnification and resultant decrease in longitudinal beam energy spread were accomplished by reducing the size of the cathode used in the electron gun. A second object of this research was to design and construct an off-axis electron gun in such a manner that the infrared radiation from the hot cathode would not reach the infrared sensitive surface of the main axis of a tube utilizing magnetic focusing. Dissert. Abstr.

N68-21804 Illinois Univ., Urbana.
1/F SURFACE NOISE IN MOS TRANSISTORS
Frank Henning Hielscher (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-6631

The low frequency noise of the MOS transistor is investigated. Different devices of the same physical size produce different magnitudes of noise and in addition the noise varies with surface potential, but no correlation between noise and substrate doping is observed. A detailed analysis of the generation-recombination of charge carriers at the surface is presented. The surface noise is calculated, resulting in a single time constant power spectrum. A simple tunneling model is then incorporated into the noise analysis to give a distribution of time constants. The exact equivalent circuit of the MOS transistor is used to justify and obtain a relationship between the equivalent gate noise resistance and the surface state conductance. Experimental noise data is presented, including frequency spectra, temperature data, and gate bias variation of the noise, as well as surface state conductance and surface state density data. Dissert. Abstr.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-20575 Illinois Univ., Urbana.
MULTI-THRESHOLD THRESHOLD LOGIC
Yao-Tung Yen (Ph.D. Thesis) 1966 71 p Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-6782

This dissertation investigates the theoretical properties of a potentially powerful logical element, called a multi-threshold threshold element. Various theoretical properties of a multi-threshold threshold element are discussed. An upper bound on the optimum weights and an upper bound on the optimum value of the difference between the largest threshold and the smallest threshold required to realize a given switching function are found. A technique to find the ordering relation on the magnitudes of weights is shown. A systematic procedure to determine the optimum structure of a multi-threshold threshold element for a switching function is presented. This synthesis procedure is guaranteed to yield the minimal number of thresholds required for any given switching function. Finally, sequences of input vectors and PN types of 2-threshold realizable functions are investigated. Dissert. Abstr.

N68-20578 Illinois Univ., Urbana.
INTERACTION OF MODULATED ELECTRON BEAMS WITH OPEN PERIODIC STRUCTURES
Andrew Richard Neureuther (Ph.D. Thesis) 1966 160 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-6688

Three electromagnetic boundary value problems involving the interaction of modulated electron beams with open periodic structures are studied theoretically with particular emphasis on producing Smith–Purcell radiation. After a brief discussion on the basic coupling process, the problem of an ideal sheet electron beam coupled to a sinusoidally-modulated reactance surface is considered. The purpose of this investigation is to demonstrate the influence of the synchronism or forced resonance condition on the interaction and to point out how the Brillouin (k–β) diagram can be used to predict some of the quantitative as well as most of the qualitative properties of this influence. Dissert. Abstr.

N68-20583 California Univ., Los Angeles.
OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS USING MULTILEVEL TECHNIQUES
David Arthur Wismer (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6407

The optimal control problem for a broad class of distributed parameter systems defined by scalar parabolic or elliptic partial differential equations is considered. The problem is solved by discretizing the spatial domain and then treating the (large) resultant set of ordinary differential equations or algebraic equations by decomposition and multilevel control where the latter term is used in the off-line sense. A decomposition technique is presented for a class of problems including a general criterion functional, a nonlinear system with time and/or space varying parameters, state and/or control variable inequality constraints, and terminal constraints with fixed final time. Dissert. Abstr.

N68-20596# Wisconsin Univ., Madison. Mathematics Research Center.
STABILIZABILITY AND OPTIMAL CONTROL
Dahlard L. Lukes Oct. 1967 21 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-822; AD-665336)

A stability-theoretic proof of the stabilizability of a completely controllable process is given. The stabilizability hypothesis is used

to develop the optimal regulator theory of linear systems and is shown to be equivalent to the solvability of Kalmans quadratic generalization of Lyapunovs linear equation. Author (TAB)

N68-20619# Michigan Univ., Ann Arbor. Radiation Lab.
NETWORK THEORY PROBLEMS IN IMPEDANCE LOADING
E. Lawrence McMahon, Arthur R. Braun, and Raymond S. Kasevich Jan. 1968 46 p refs
(Contract AF 19(628)-2374)
(Rept.-5548-8-T; AFCRL-68-0027; SR-8; AD-665472)

Relationships between the real and imaginary parts of an impedance are studied. Given the real and imaginary parts in a finite frequency band, a technique is developed for finding these parts outside the band. Conditions under which the real part remains positive for all omega are given. Use of a negative impedance converter for realization of a particular impedance arising from impedance loading studies is discussed. A method of compensating for collector capacitance and extending operation of a transistorized NIC into the VHF region is given. Author (TAB)

N68-20631 Illinois Univ., Urbana.
SOLUTION OF THE FINITE LENGTH SEPTUM PROBLEM BY SCATTERING MATRIX TECHNIQUES, WITH APPLICATION TO PERIODIC MODE SUPPRESSORS
Sidney Bruce Franklin (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6612

A square waveguide with periodic septums is considered with a view towards determining the parameters of a structure which suppresses three of four possible propagating modes. The analysis is presented in two parts, the first of which is concerned with the isolated septum. Using available techniques, semi-infinite scattering matrices are determined for the semi-infinite septum for arbitrary TE_{N0} TE_{N1} and TM_{N1} incident modes. The solutions are evaluated for several frequencies, and fifth order polynomials are fitted for the computation of the scattering matrix elements S_{11} and S_{12} The analysis for the TE_{10} mode is applicable to an arbitrary height waveguide and may be used without modification for the finite length septum in conventional waveguide. The second part is concerned with the periodic waveguide and assumes that the septums are far apart. A contour chart is introduced to visualize the performance of the periodic structure. Dissert. Abstr.

N68-20676 Illinois Univ., Urbana.
CONTROL SYSTEM SYNTHESIS TO MINIMIZE MULTIPARAMETER SENSITIVITY
Richard Lawrence Gonzales (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-6618

A new multiparameter sensitivity index for control systems is introduced in this thesis. This measure of the deterioration in the system performance is based either on the integral square error or the mean square error in the system response due to parameter variations. A first order approximation to the change in the system transmission is used to simplify these functions. The index is extended to include situations when the varying parameters are stochastic. The expected value of the index with respect to the parameters is employed under these conditions. Moreover sensitivity analysis techniques for worst case conditions are developed to deal with parameter specifications in the form of tolerances. Synthesis procedures are derived which permit the minimization of the control system sensitivity with respect to the parameters. These procedures are investigated in terms of the control system stability and physical realizability. Dissert. Abstr.

N68-20678 Princeton Univ., N. J.
SOME MINIMIZATION PROBLEMS IN THE DESIGN OF GATE-TYPE COMBINATIONAL SWITCHING NETWORKS
James Francis Gimpel (Ph.D. Thesis) 1966 324 p
Available from Univ. Microfilms: HC $14.65/MF $4.15 Order No. 67-5717

It is shown that any arbitrary covering problem can be interpreted as the covering problem associated with the two-level minimization of some Boolean function. A new reduction technique for prime implicant tables is developed. It is also shown that the minimal sum of a disjoint composite of Boolean functions can be obtained under certain circumstances by a composition of minimal sums. Several applications are described, among which is a new method of detecting decompositions. A CC-table (cover and closure table) is an extension of a prime implicant table. An algorithm is presented for finding minimal TANT networks (three-level AND-NOT networks with true inputs) and this problem is shown to also reduce to solving a CC-table. An algorithm is presented for finding a minimal OR/AND/OR network and this problem too reduces to solving a CC-table. Some general aspects of CC-tables are studied and a new reduction technique is given. Dissert. Abstr.

N68-20704 California Univ., Berkeley.
STABILITY OF TIME-VARYING FEEDBACK SYSTEMS
Andre Jean Rault (Ph.D. Thesis) 1966 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-5147

For a general model of a nonlinear time-varying system, it is shown that satisfaction of an inequality yields absolute input–output stability. For specialized models, it is then shown that satisfaction of a positivity condition is sufficient for this inequality to hold. For a stationary nonlinearity and a linear time-varying plant, the positivity condition takes the form of the passivity condition for a linear time-varying network. In the case when the time variation appears as a single time-varying gain, the positivity condition reduces to simple frequency criteria. If the derivative of the gain is nonpositive after a finite time, the Popov criterion is sufficient to establish absolute input–output stability of the system. Finally, for linear systems containing a single time-varying gain element, it is proved that the Popov criterion and a time domain inequality are sufficient conditions to guarantee uniform asymptotic stability. Dissert. Abstr.

N68-20747# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
PROVIDE PAYLOAD FOR AEROBEE ROCKET, REFURBISH AND TEST A LUNAR POINTING CONTROL AND TELEMETRY SYSTEM Final Report, 13 Jun. 1966–31 Jul. 1967
Vernon L. Stone, Frank E. Wise, Martin Cunningham Nov. 1967 38 p
(Contract AF 19(628)-6040)
(AFCRL-67-0647; AD-665896)

This work covered the mathematical analysis of the servo electronic system used in both the solar and lunar Model III Biaxial Pointing Controls developed by the University of Colorado. The Laplace transform was used in the mathematical study. As of the date of this report, the study is incomplete due to the difficulties of evaluating certain physical constants. However, further work is being done and should prove the value of the mathematical study which has been done. Author (TAB)

N68-20850 Ohio State Univ., Columbus.
THE USE OF COMPUTER-GENERATED MOTION PICTURES IN THE ANALYSIS OF ELECTRICAL ENGINEERING PHENOMENA
Brenton Robert Groves (Ph.D. Thesis) 1966 381 p
Available from Univ. Microfilms: HC $17.35/MF $4.90 Order No. 67-6316

The purpose of this work was to apply computer-generated motion pictures to the analysis of electrical engineering phenomena. Electrical engineering as a field suffers from the fact that many physical events can only be explained mathematically. In order to

increase understanding, it is possible to use the digital computer and a graphic display device to plot out a graph or picture of the mathematical representation. The degree of abstraction in Maxwell's equations makes them a particularly attractive subject for application of this technique. Therefore, a number of subjects are discussed in electromagnetics. The main advantage of a computer-generated motion picture over that of a still picture is that either time or motion can be used as an additional parameter. Time can be incremented between each frame, or one of the variables in an equation can be varied and the resulting motion displayed. Dissert. Abstr.

N68-20855 Princeton Univ., N. J.
PEFORMANCE OF A COMPUTER CONTROLLED "OPTIMUM SWITCHED" SYSTEM IN THE PRESENCE OF NOISE
Jan Alexander Norton (Ph.D. Thesis) 1966 690 p
Available from Univ. Microfilms: HC $31.05/MF $8.75 Order No. 67-5743

This thesis investigates the operation of an "optimum switched" system with "information" constraints, for a linear second order plant ($\ddot{x} + ax = b\dot{x} = \pm 1$). The "information" constraints are: the use of a digital computer as the switching controller, the measurement of the plant state with noisy instruments, and the inexact knowledge of the coefficients of the plant equation. The use of a digital computer introduces sampling and quantization of the measured state variables, a delay due to the data processing time, and a plant input which is constant during a sampling period. The idealized system operation, without the "information" constraints, was considered by D. W. Bushaw in his original analysis of time-optimal switched systems. The control algorithm is based on Bushaw's optimum switch curves. Dissert. Abstr.

N68-20886 Princeton Univ., N. J.
TREATMENT OF DELAYS IN ASYNCHRONOUS NETWORKS
Andrew Douglass Hall, Jr. (Ph.D. Thesis) 1966 171 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-5722

Procedures are described for analyzing a model for asynchronous networks which are formed by interconnecting basic logical elements, called decision elements. A decision element is assumed to have a number of inputs but only a single output. This output is specified by a combinational function of the inputs each of which has an associated delay of unknown magnitude. These delays are assumed to exist in order to account for delays which occur in the network interconnections and within the decision elements. The analysis procedures use the functions which describe the decision elements in a network and are intended to provide an alternative to examining all possible sequences of states. A procedure is given which can be used to determine, for any initial state, the range of signal values which ultimately can occur on output of a decision element. Dissert. Abstr.

N68-20931# Montana State Coll., Bozeman. Engineering Research Labs.
BIBLIOGRAPHY OF THE CELLULAR LITERATURE
Robert C. Minnick, Bela I. Marton, and Lynn E. Cannon 12 Oct. 1967 68 p refs
(Contract N00014-67-C-0477)
(AD-665330)

This bibliography is intended to serve those research workers who are concerned with cellular or iterative logic. The first portion is a listing on key words; an alphabetical author index appears in the second portion. Author (TAB)

N68-21012# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
AN ALGORITHM FOR DISCRETE-TIME STOCHASTIC OPTIMAL LINEAR CONTROL
J. S. Meditch Jan. 1968 26 p refs *Its* Inform. Sci. Rept.-11
(D1-82-0695; AD-665719)

A forward-time-recursive algorithm for the optimal control of discrete-time stochastic linear systems is developed. The procedure which is employed to develop the algorithm consists in utilizing the Kalman filter to obtain the optimal estimate of the systems error and then determining the time-varying feedback control gain matrix to minimize the weighted mean-square error at each time. The resulting algorithm can be readily implemented with a digital computer. The presentation is concluded with a discussion of the advantages, disadvantages, properties, and possible extensions of the results. Author (TAB)

N68-21063 California Univ., Los Angeles.
VARIABLE TIME OPTIMAL CONTROL
Robert Arthur Niemann (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6186

When solving the optimal control problem for a given set of differential equations, one obtains a minimum S(T,X) for the given performance criterion for each final time T and each fixed end point X. The variable time problem and variable end point problem involve determining the minimum of S(T,X) as a function of T and X, respectively. In solving the variable time problem, one employs the necessary condition that the Hamiltonian $H = 0$ for variable time optimum. A computational algorithm using this condition is derived. However, since $H = -\partial S/\partial T$, this necessary condition also holds for a local maximum of S(T,X). This paper explores the problems involved in using this necessary condition and gives a numerical example for which S(T,X) has several local maxima and minima. A sufficient condition for a local minimum of S(T,X) with respect to T and a computational algorithm employing this condition are derived. Dissert. Abstr.

N68-21064*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
ANALYSIS AND SYNTHESIS OF DISTRIBUTED-LUMPED ACTIVE NETWORKS BY DIGITAL COMPUTER Semiannual Report, 1 Sep. 1967–29 Feb. 1968
L. P. Huelsman 29 Feb. 1968 12 p refs
(Grant NGR-03-002-136)
(NASA-CR-93972) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Means of applying digital computing techniques to analysis and synthesis of DLA (distributed, lumped, and active) elements was studied; and advantages of such realizations over a purely lumped network as well as their application to integrated circuitry are considered. Synthesis of DLA networks by various optimization techniques, properties of generalized multi-terminal distributed elements, and use of state variable techniques to provide a representation for DLA networks are under investigation. M.W.R.

N68-21122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLLISIONLESS CYLINDRICAL DIODE
Charles M. Goldstein Washington Apr. 1968 41 p refs
(NASA-TN-D-4516) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A complete formulation and numerical results for the collisionless space-charge problem of a cylindrical diode with thermionically emitted electrons are presented. This formulation allows calculation of the current-voltage characteristics from the Schottky retarding region to saturation. In addition, the onset of the Schottky retarding region is unambiguously defined. Author

N68-21408# Atomic Energy Commission Research Establishment, Riso (Denmark).
ELECTRONICS [BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1. APRIL TIL 30. JUNI 1967] Quarterly Report, 1 Apr.–30 Jun. 1967
Sep. 1967 31 p refs In DANISH; ENGLISH summary
(RISO-M-626; R-17-67) CFSTI: HC $3.00/MF $0.65

A summary is given of some department activities: digital equipment for measurement of fast transients, conductivity measurement and temperature control of liquids, and hybrid-computer calculations (PDP-8 and EAI-680). NSA

N68-21556# Illinois Univ., Urbana. Coordinated Science Lab.
STABILITY OF A CLASS OF LUMPED-DISTRIBUTED SYSTEMS
Jack Jules Bourquin Jan. 1968 128 p refs
(Contract DAAB-07-67-C-0199; Grant AF-AFOSR-931-67)
(R-373; AD-666219)

Bounded input-bounded output stability is investigated for active, time-invariant, linear lumped-distributed systems of a class for which transfer functions are functions of s, the square root of s, and e raised to the power (the square root of s), in which s is the complex frequency variable. TAB

N68-21561# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
COORDINATION OF ACTIVITY IN THE FIELD OF ELECTRONICS AND INSTRUMENTATION. REPORT 2: AUTOMATION AND CONTROL [COORDINAMENTO DELLE ATTIVITA NEL CAMPO DELL'ELETRONICA E DELLA STRUMENTAZIONE. RAPPORTO NO. 2: AUTOMAZIONE E CONTROLLO]
B. Rispoli 1967 235 p refs In ITALIAN
(RT/EL(67)14) CFSTI: HC $3.00/MF $0.65

The research of the electronics laboratories centered on nuclear reactor construction. The articles cover: some results of an optimum method of synthesizing threshold elements in the presence of noise, modified complex electronic structures for nuclear experiments, and adding threshold elements to arrive at delta variable. The instrumentation laboratories concentrated on automatic control of nuclear reactors. This included: instrumentation for reactor control, logarithmic amplification and the time cycle for automatic control of nuclear reactors, electronic multiplier as a division of time, and system for the automatic analysis of scintillations. Transl. by F.S.

N68-21578# Case Western Reserve Univ., Cleveland, Ohio.
ANISOTROPIC MEDIA AND NETWORK SYNTHESIS Final Report, Oct. 1, 1962–Sep. 30, 1967
Robert E. Collin and Dov Hazony Oct. 1967 52 p refs
(Contract AF 19(628)-1699)
(AFCRL-67-0606; AD-665146)

In this final report a summary of the work carried out on Contract AF19(628)1699 is given. Part I covers the work done on guided wave propagation in plasma filled waveguides, radiation by a line source through a warm plasma slab, evaluation of the surface wave mode on a plasma column as a diagnostic probe to measure electron density and collision frequency, electron cyclotron radiation in waveguides, and a study of beam-plasma interaction. Part II summarizes the work done on network synthesis in the areas of n-port synthesis, RC-unity gain amplifier transfer vector synthesis, reduction in number of elements in vector synthesis and the interpolation problems. Author (TAB)

N68-21598# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SCHOOL OF ELECTRICAL ENGINEERING SEVENTH SEMIANNUAL RESEARCH SUMMARY, JULY–DECEMBER 1967
Dec. 1967 143 p refs
(Contract N00014-67-A-0226-0004)
(AD-666380)

Contents: Medical and life sciences; Control and information systems; Electrical power systems; Electromagnetic fields; Electronic systems research laboratory; Materials and electron devices; Laboratory for agricultural remote sensing. TAB

N68-21677# General Electric Co., Schenectady, N. Y. Research and Development Center.
OPTIMAL CONTROL FOR THE ENGINEER. 1: THEORETICAL FOUNDATIONS
K. W. Jenkins and H. A. Spang, II Apr. 1967 79 p refs
(Rept.-67-C-129) Available from GE, Res. and Develop. Center, P.O. Box 8, Schenectady, N. Y. 12301

The theoretical aspects of optimal control have been extensively investigated in recent years. Unfortunately, the number of actual systems which have been designed using these techniques is quite small. There are primarily two reasons for this. First, the theoretical results have been obtained by mathematicians and are often found to be unreadable by the average engineer. Second, the solution of optimal control problems generally require sophisticated computational techniques. This report is aimed at easing the first difficulty by presenting what is hoped to be a clear and fairly thorough account of the theory of optimal control written for the nonspecialist. The aim is to promote the use of optimization techniques by educating potential users as to what optimal control will and will not do. Author

N68-21791 California Univ., Los Angeles.
NON RECIPROCAL SOLID STATE PLASMA WAVEGUIDES
Norman Bruce Kramer (Ph.D. Thesis) 1966 165 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-6183

A strong non-reciprocal effect exists for solid state plasma waveguides in a transverse magnetic field. This dissertation contains an experimental and theoretical study of this effect in relation to its possible applications. The construction and performance of low insertion loss "true" waveguides are described. Certain new methods are developed for the theory of solid state plasma waveguides that may be useful for more general types of waveguides. Dissert. Abstr.

N68-21807# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
ADAPTIVE COMPONENTS [COMPONENTI ADATTIVI]
G. V. Pallottino and A. Sano 1967 113 p refs In ITALIAN; ENGLISH summary
(RT/EL(67)11) CFSTI: HC $3.00/MF $0.65

The practical realization of high performance, high reliability learning control systems can be carried out by means of threshold elements using suitable electronic components, called adaptive components. The characteristics (linearity, stability, cost, etc.) of such components, that consist essentially of analog memory elements are discussed. A review is made of all the adaptive components, based on different physical principles, proposed and realized, and a critical comparison is made of the components to be applied in learning electronic systems. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-20723# Battelle Memorial Inst., Columbus, Ohio.
VALIDATION OF DESIGN THEORY FOR AIRCRAFT ARRESTING-GEAR CABLE Final Report, 5 May 1965–4 Dec. 1967

Philip T. Gibson, Graham H. Alexander, and Hobart A. Cress 19 Jan. 1968 88 p
(Contract NOw-65-0503-C)
(AD-665328)

The five wire ropes selected for evaluation included four flattened-strand and one round-strand construction. The standard rope design presently in use for deck pendants was used as a basis of comparison for all tests. These wire-rope constructions were subjected to a series of tests to establish their suitability for use as arresting cable. The report discusses the selection of the new rope designs and the results of the testing program. Tests on these wire ropes included evaluation of (1) ultimate strength, (2) elastic modulus, (3) torsion, (4) flexibility, and (5) resistance to damage by transverse impact. The tests of ultimate strength, elastic modulus, and torsion were conducted in the test laboratories of the rope manufacturers. Rope tension, torsion, and elongation were measured. Tests of flexibility and resistance to transverse impact were conducted. The transverse-impact tests required the design and construction of special apparatus utilizing an explosive-powered arresting hook. With this equipment, specimens of each wire-rope construction were impacted with the arresting hook at velocities equivalent to the landing speeds of aircraft on carriers. These impact tests proved to be the most satisfactory method of evaluating deck-pendant ropes in the laboratory. TAB

N68-20767# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
ANALYSIS AND DESIGN OF A HIGH PRESSURE AC ARC HEATER Final Technical Report, Jan. 1964–Jul. 1966
Donald E. Geister Wright-Patterson AFB, Ohio ARL Dec. 1967 121 p refs
(Contract AF 33(615)-1326)
(ARL-67-0276; AD-665825)

The work reports on the analysis and design of an A.C arc heater capable of steady state operation of 2500 psia. Included are discussions on the problems of designing an arc heater for a new operational regime. A generalization on the arc column-gas flow interaction is postulated whereby all arc heaters are divided into two types. Specifying each group as either a parallel or normal flow arc heater the problem of scaling each type is discussed. Scaling trends were found for each type and presented. Using the results of the scaling studies and previous experimental data, detailed studies concerning the material selection, expected heat transfer rates, stress levels, and the required cooling systems are presented. Author (TAB)

N68-20802# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SNOW AND ICE PROPERTIES AS RELATED TO ROADS AND RUNWAYS IN ANTARCTICA
Gunars Abele and Guenther Frankenstein Oct. 1967 45 p refs
(CRREL-TR-176; AD-665386)

Dynamic tests were performed to determine the Youngs modulus of sea ice, derived from longitudinal wave velocities measured with a soniscope. Static tests consisted of standard ring tensile strength and simple beam or flexural strength tests. The strength data were plotted on a base of the brine volume for each test. The test results indicate that the annual sea ice at McMurdo Sound is capable of supporting cargo type aircraft. Snow runways capable of supporting a C-130 aircraft on wheels and providing marginal support to a C-121 can be constructed either with the Peter plow or with the pulvimixer. However, the runway would be reliable only during comparatively low temperatures (< -15C). Peter snow miller processing and bulldozer compaction methods appear to be feasible for effective depth processing and compaction of high strength snow pavements. The criteria for support of various types of aircraft on a snow runway are presented.
Author (TAB)

N68-20894# McGill Univ., Montreal (Quebec).
GENERAL DESCRIPTION AND CALIBRATION OF THE McGILL 30-INCH DIAMETER BLOWER CASCADE WIND TUNNEL
W. M. Vogel Mar. 1968 37 p refs
(Grant DRB-9551-12)
(TN-68-1) CFSTI: HC $3.00/MF $0.65

The circular, open-jet wind tunnel is driven by a centrifugal fan with a variable speed dc motor for speed control and incorporates an axisymmetric contraction of 7.2:1 area ratio. The tunnel is intended mainly for studying axisymmetric turbulent wakes and jets. Such measurements include the use of hot wire anemometers, and to improve their performance the incoming air is filtered with high efficiency filters. The tunnel includes a wide angle expansion section of novel design. The tunnel speed can be adjusted from less than 1 ft/sec to 124 ft/sec, with maximum spatial variation of velocity of less than .3% outside the boundary layers (which are .35 inches thick). The longitudinal intensity of turbulence outside the boundary layers is less than .2% and appears to be essentially independent of velocity. Author

N68-20943*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECTS OF LITHIUM AND POTASSIUM ON A Cb–1Zr RANKINE CYCLE TEST LOOP
W. M. Phillips 1 Apr. 1968 17 p refs
(Contract NAS7-100)
(NASA-CR-93910; JPL-TR-32-1254) CFSTI: HC $3.00/MF $0.65 CSCL 18J

A Cb–1Zr lithium-boiling potassium test loop was operated for roughly 1000 h at temperatures up to 1900°F. Observations made during a scheduled shutdown indicated no corrosion of the potassium section of the loop and only superficial erosion as a result of low-vapor-quality operation. No mass transfer was observed in either loop. Superficial etching was observed in the hot areas of the lithium system. Carbon transfer occurred in both loops and nitrogen transfer was detected in the lithium system. Author

N68-20992*# National Aeronautics and Space Administration, Washington, D. C.
GODDARD SPACE FLIGHT CENTER, GREENBELT, MARYLAND
[1967] 4 p
(NASA Facts-0-5/10-67) CSCL 22D

Search for new knowledge and overall philosophy of the Goddard Space Flight Center is mentioned in a NASA fact sheet that discusses research related to scientific satellites, applications satellites, and tracking and communications. Responsibility of Goddard is for the development of unmanned orbiting satellites in the interest of basic and applied science, sounding rocket experiments, and the NASA worldwide network of tracking stations serving both manned and unmanned scientific space missions.
M.W.R.

N68-21014# Avco-Everett Research Lab., Everett, Mass.
ON A NEW SOURCE OF HIGHLY STRIPPED HEAVY IONS
J. D. Daugherty, L. Grodzins, G. S. Janes, and R. H. Levy Jan. 1968 11 p refs
(Contracts AF 49(638)-1553; AT(30-1)-3863)
(Avco-Everett Res. Rept.-288; AFOSR-68-0348; AD-665866)

A new source of highly stripped heavy ions is suggested based on the principles of the HIPAC (Heavy Ion Plasma Accelerator). The mode of operation and estimated performance of the ion source are discussed and a brief description of relevant experiments is given. Based on an electron density of 2 x 10 to the 10th per/cc and a containment time of 10 seconds, it should be possible to produce, for example, U+60 (60 times ionized uranium) at a rate of 10 to the 11th power ions per second. Author (TAB)

N68-21239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY. 18: LAUNCH OPERATIONS
Maynard I. Weston Washington 1968 22 p refs Presented at Lewis Aerospace Explorers Conf., Cleveland, 1966–1967
(NASA-TM-X-52405) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The hardware, organization, testing, and support of a typical launching of the Atlas-Agena-Orbiter is discussed. The facilities necessary for launching the spacecraft are listed, and a brief description of the two major portions of the launch complex, the blockhouse and the test stand, is included. The overall organization of government and contractor elements responsible for the Lunar Orbiter prelaunch operations is given along with an outline of the prelaunch tests and operations. In order to understand the support required from the tracking and telemetry stations around the world, a brief review of a typical Lunar Orbiter flight plan is presented. The location of the major NASA ground-based communication stations is also reported. B.S.D.

N68-21295# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
DEVELOPMENT OF A SEEDING TECHNIQUE FOR HYPERSONIC SHOCK TUNNEL USE
J. K. Dukowicz Mar. 1968 72 p refs
(CAL-AE-2064-Y-1)

A seeding technique intended for routine operational use in a hypersonic shock tunnel was developed. Suitable for use with any alkali halide, it is capable of seeding air as well as the inert gases both above and below atmospheric pressure in the driven tube. The technique consists of generating and flowing an aerosol of the seed particles through the driven tube at a sufficiently high velocity to minimize the effects of settling during the particle transit time, achieving a uniform, steady state distribution of the seed material. A series of tests in the 96-inch Hypersonic Shock Tunnel using potassium iodide (KI) seed material in nitrogen was carried out. Information on seed distribution and ion and electron number densities was obtained. A range of conditions was covered in the tests, varying seed concentration, incident shock Mach number, density level, and nozzle area ratio. The experimental results are compared with nonequilibrium nozzle expansion calculations made using estimated reaction rates. Good agreement is obtained at low enthalpy conditions ($M_i \approx 5$) but rather poor agreement at higher enthalpies ($M_i \approx 8$) which most likely is due to the uncertainty in the reaction rates. The seeding technique was found to be practical, indicating that satisfactory uniformity of seed distribution was achieved. Author

N68-21513# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC CHANNEL [MAGNITNYY KANAL]
A. L. Bezbatchenko and E. I. Sadovskiy 7 Jul. 1967 20 p Transl. into ENGLISH from Akad. Nauk SSSR. Inst. At. Energii (Moscow), 1966 p 1–15
(FTD-MT-24-91-67; AD-666144)

Article presents a description and analysis of the magnetic channel used for injection of molecular ions of hydrogen with energy of up to 160 keV into a magnetic field of the Ogra trap with intensity of up to 3500 oersted at an angle of from 0 to 35 degrees to plane perpendicular to axis of trap. Channel consists of a bent iron pipe of rectangular cross section and has compensation and deflection windings. Design of the channel allows heating it in a vacuum chamber to a temperature of 400C. Author (TAB)

N68-21552# Princeton Univ., N. J. Dept. of Civil and Geological Engineering.
STRENGTH RESPONSE PARAMETERS OF NATURAL SOIL SURFACES AND THEIR APPLICATION TO THE LANDING PROBLEM OF AIRCRAFT Scientific Report, 19 Jan. 1966–18 Jan. 1967
Keui-wu Tsai 18 Jan. 1967 84 p refs *Its* Soil Eng. Res. Ser. No. 10
(Contract AF 19(628)-5873; Grant NSF GP-579)
(AFCRL-67-0583; SR-1; AD-666055)

A suitable rheological model is found to represent the soil deformations under impact loads. The parameters of the model are evaluated from the deceleration history curves of the Princeton impact penetrometer tests. From the soil parameters obtained, the soil responses under the airplane landing load are estimated. Extensive applications to the dynamical soil problems, such as soft landing of spacecraft, will be possible. Author (TAB)

N68-21621# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
CHARACTERISTICS OF A HIGH PRESSURE A.C. ARC HEATER SYSTEM
Donald E. Geister Wright-Patterson AFB, Ohio ARL Dec. 1967 104 p refs
(Contract AF 33(615)-1326)
(ARL-67-0217; AD-666432)

The report summarizes the design, development, and testing of an A.C. arc heater system with a projected capability of steady state operation at 2500 psia. The basic components of the system are described and the requirements imposed on each system component by the high operational pressure levels are given. These requirements were established, in part, by experimental data obtained from a previously built low pressure A.C. arc heater (500 psia). These data coupled with the analytic studies on the design of the high pressure arc heater dictated a completely new arc heater system. The development of this system is presented and the necessary specifications of each component are outlined. The design details of the arc chamber, end closures, nozzle and electrode system are shown. Experimental data are given which establish the performance characteristics of the arc heater. The unit was operated at pressure levels up to 1400 psia with power inputs over 1 Megawatt. A new electrode configuration was devised which significantly increased the arc heater efficiency. It is concluded that with further development in A.C. arc heater can operate at the 2500 psia levels and that this type of unit would be an effective driver for a hypersonic tunnel. Author (TAB)

N68-21722# Stanford Univ., Calif. Linear Accelerator Center.
RF CAVITY FOR SLAC STORAGE RING
M. A. Allen, L. G. Karvonen, and R. A. McConnell Oct. 1967 35 p refs
(Contract AT(04-3)-515)
(SLAC-78) CFSTI: HC $3.00/MF $0.65

The electric design of the radiofrequency cavity for the proposed SLAC storage ring is discussed. Expressions are derived for the required tuning and coupling adjustments as a function of beam current. The mechanical design and fabrication are described in detail under the following categories: materials, fabrication stress relief, final assembly, flanges vacuum system, tuning, and cooling. The performance characteristics of the rf cavity are also presented. NSA

N68-21763*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NASA'S 150-METER METEOROLOGICAL TOWER LOCATED AT THE KENNEDY SPACE CENTER, FLORIDA
John W. Kaufman and Lester F. Keene Jan. 1968 18 p Revised Supersedes NASA-TM-X-53259 See N65-25971
(NASA-TM-X-53699; NASA-TM-X-53259) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This report describes the basic functional operations of NASA's 150-meter Meteorological Tower Facility located in the Merritt Island Launch Area at KSC, Florida. Meteorological instrumentation and data acquisition schemes for obtaining lower atmospheric profile measurements of temperature, winds, and humidity are discussed. Author

N68-21816# Sandia Corp., Livermore, Calif.
INFLUENCE OF CAPACITOR BANK PARAMETERS ON MAGNETICALLY DRIVEN FLYER PLATES
D. B. Nelson Dec. 1967 14 p
(Contract AT(29-1)-789)
(SCL-DR-67-116) CFSTI: HC $3.00/MF $0.65

The effect of varying capacitor bank parameters on the performance of magnetically dirven flyer plates is described. The equations relating magnetic impulse to bank parameters are derived and some typical curves presented. It is shown that the slow, high-energy bank, though less efficient, is capable of producing equally sharp and ultimately greater impulses than the fast, low-energy bank. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-20576 Iowa State Univ. of Science and Technology, Ames.
NUMERICAL SOLUTION OF THE NAVIER–STOKES EQUATIONS FOR THE ENTRANCE REGION OF SUDDENLY ACCELERATED PARALLEL PLATES
Jerry Dean Pearson (Ph.D. Thesis) 1966 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-5611

This dissertation reviews several of the published investigations related to solution of the Navier–Stokes equations by numerical methods and describes a new study of the time dependent, constant property Navier–Stokes equations in two spatial dimensions. The numerical technique used employs an alternating direction implicit method to solve the parabolic partial differential equation of vorticity transport, and a successive block or line overrelaxation method to solve the elliptic equation relating the stream function and the vorticity. An iterative scheme is used to combine these two equations. Dissert. Abstr.

N68-20617 Rutgers Univ., New Brunswick, N. J.
A STUDY OF THE FLUID TURBULENCE ENERGY SPECTRUM IN A GAS SOLID SUSPENSION
John P. Wallace (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5286

The longitudinal intensity of the suspension fluid turbulence and the longitudinal spectrum in a gas–solid suspension was measured in the center of 3" square duct using a glow discharge probe. For a mean velocity of 85 fps and a solids loading ratio of .465 pounds of .0058" diameter glass beads per pound of air the intensity in the center of the duct was shown to decrease by an average of 22%. Upon introduction of the particles the spectrum of the fluid showed a modulation effect in which the energy density at low frequencies decreased and the energy density at high frequencies increased. The constant temperature anemometer spectrum and the glow discharge spectrum were compared and agreed well through 5000 cps. Beyond this value the two techniques showed a marked deviation. An analysis of the high wave number portion of the spectrum using the Pao transfer function and assuming that the particles produce a uniformly distributed volume force described by the Stoke's drag predicts the behavior of the measured spectrum. Dissert. Abstr.

N68-20622 Oregon State Univ., Corvallis.
EFFECTIVENESS OF A FLUIDIZED BED IN FILTRATION OF AIRBORNE PARTICULATE OF SUBMICRON SIZE
Charles Hartgraves Black (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5646

Submicron particulate (mean size of 0.52 microns) was filtered from air at atmospheric temperature and pressure by passing air through a bed of fluidized glass shot in a two inch column. Percentage removal of particulate from the air stream was constant during the life of the bed and independent of the entering concentration over the range of 0.1 to 5 milligrams per cubic meter. Varying superficial gas flow rates from 8.75 to 25 feet per minute and bed heights from 5 to 12 from inches, resulted in filtration efficiencies ranging from 50 to 90%. Efficiency improved with increased bed height and decreasing superficial gas flow velocities. Inertial impaction forces may be considered negligible. The predominant effects are Brownian diffusion, direct interception and induced electrostatic attraction. An equation is presented describing effective filtration efficiency as a function of mean sizes of challenging aerosol and bed material, air viscosity and density, bed height-to-diameter ratio, and superficial gas flow velocity. Analyses and tests indicated particulate approximately 0.5 micron in diameter to be the most difficult to remove. Dissert Abstr.

N68-20623 Illinois Univ., Urbana.
FLOW REGIME TRANSITIONS AT ELEVATED PRESSURES IN VERTICAL TWO-PHASE FLOW
James Lee Lawrence Baker, III (Ph.D. Thesis) 1966 233 p
Available from Univ. Microfilms: HC $10.60/MF $3.05 Order No. 67-6548

Two-phase flow regime transitions at elevated pressures for a single-component fluid, trichloromonofluoromethane (Refrigerant-11), were investigated for forced-circulation, upward flow in a vertical rectangular conduit with internal dimensions of 0.380 by 1.050 inches. The two-phase mixture was generated by an electrically heated tube at constant heat flux, which ranged from 4,000 to 74,000 Btu per hour per square foot, for mass flow rates from 0.20×10^{6} to 2.0×10^{6} pounds per hour per square foot. The orthobaric density ratio ranged from 7 to 60. The mass qualities based upon thermodynamic equilibrium ranged to ninety percent; however, the majority of the data encompassed the segment from saturation to fifty percent. The flow regimes were observed in the unheated rectangular section by employing an X-ray and television monitoring system. High speed color motion pictures were obtained which utilized a technique of directing blue light from above and red light from below the camera centerline to provide a method for distinguishing liquid from vapor due to inversion of the color pattern. Dissert. Abstr.

N68-20891# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TURBULENT NONISOTHERMAL JETS OF A COMPRESSIBLE GAS OF VARIABLE COMPOSITION
A. S. Ginevskii 30 Nov. 1967 43 p refs Transl. into ENGLISH from Prom. Aerodinamika (USSR), no. 27, 1966 p 31–54
(Contract NOw-62-0604-c)
(APL-TG-230-T-538; AD-665593)

A compressible turbulent jet of variable composition is analyzed using the integral method. The analysis is divided into six parts, with the following assumptions holding throughout: the flow is isobaric, the specific heat of each component in the jet is temperature-independent, pressure and thermal diffusion are neglected, the density is determined from the Clapeyron equation, and there are no chemical reactions. Part 1 treats a plane nonisothermal jet in a wake with Pr sub t = Pr sub d = 1 at high velocities, the governing boundary layer equation, and the energy equation. In Part 2, the same problem is analyzed for an axisymmetric jet. Part 3 is the same as Parts 1 and 2 combined, except that the flow velocity is assumed to be very low. The results of the analysis are shown as velocity profile curves for various radial temperature distributions. In Parts 4-6, the conditions Pr sub t = Pr sub d = 1 are relaxed. Author (TAB)

N68-20697# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
COMPRESSIBLE TURBULENT PLANE COUETTE FLOW
Robert H. Korkegi and Ronald A. Briggs Nov. 1967 30 p refs
(ARL-67-0223; AD-665863)

Equations describing compressible turbulent plane Couette flow for the case of equal heat transfer at both walls were developed for a perfect gas based on the von Karman mixing length model. This model was selected because of its good agreement with available turbulent plane Couette flow measurements of incompressible flow and furthermore, lacking compressible Couette flow data, it is shown by Spalding and Chi that those theories based on the von Karman model give best agreement with compressible turbulent boundary layer measurements. A sample calculation is given for the heat rate to the inner surface of a rail-guided slipper (representative of slippers supporting rocket boosted sleds) based on the assumption of a small air gap between both surfaces. Author (TAB)

N68-20699# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SOLUTIONS OF LAMINAR BOUNDARY EQUATIONS WITH EMPHASIS ON SEPARATION. PART 1: EXACT METHODS. PART 2: INTEGRAL METHODS
Karlhein O. W. Ball and Wilbur L. Hankey Dec. 1967 108 p refs
(ARL-67-0273; AD-665823)

Exact and integral methods of solution for steady, laminar, two-dimensional boundary layers are presented. TAB

N68-20700 Oklahoma Univ., Norman.
GAS ABSORPTION INTO THIN WAVY LAMINAR LIQUID FILMS FALLING DOWN INCLINED PLANES
Harry Warner Merritt, Jr. (Ph.D. Thesis) 1967 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-3977

Gas absorption into thin laminar liquid films with both smooth and wavy surfaces falling down inclined planes was investigated for angles of 1°, 2°, 3°, 5°, 10°, 15°, and 25° from the horizontal at Reynolds numbers varying between 140 and 1940. In a flat plate diffusion cell, experimental measurements were made of the mean film thickness, the characteristics of the surface disturbances, the bulk concentration of dissolved gas, and the light interference patterns that formed as a result of the diffusion of CO_2 into the water films. A theoretical study was made of the molecular diffusion process into the thin films when the surface was both smooth and wavy. Results indicate that wall effects can have a significant bearing on the flow and mass transfer into the films. The interference profiles formed as a consequence of the CO_2 diffusion seem to represent other properties in addition to the solute distribution. Dissert. Abstr.

N68-20730 Minnesota Univ., Minneapolis.
EXPERIMENTAL INVESTIGATION OF THE FLOW FROM A FLUID AMPLIFIER NOZZLE
William Edgar Bevier (Ph.D. Thesis) 1966 339 p
Available from Univ. Microfilms: HC $15.30/MF $4.35 Order No. 67-5

This thesis presents and analyzes the results of an experimental investigation pertaining to a nozzle configuration which typifies a particular class of fluid amplifier. The results prove that the exponential type of function commonly applied to the representation of free turbulence does not adequately define the flow field downstream from the subject nozzle configuration. This inadequacy occurs because all exponential curves of this form have identical normalized velocities at the inflections of the curves, and all are symmetric. A curve called the Beta Curve is shown to be superior to the exponential curve for the thesis data. A parameter called Peakedness is defined for the Beta Curve as the ratio of the maximum velocity to the geometric average of the inflection velocities. This parameter is demonstrated to govern the qualities of amplification and linearity of the nozzle configuration. A regression analysis of this peakedness parameter for the accumulated data is used to establish a design criterion which can be utilized to optimize the static characteristics of the fluid amplifier. Dissert. Abstr.

N68-20731 Connecticut Univ., Storrs.
EFFECT OF BUOYANCY ON LAMINAR VERTICAL JETS
Frank Joseph Lahey (Ph.D. Thesis) 1966 41 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-3896

The effect of buoyancy on a vertical, heated jet of incompressible fluid, emerging from an orifice into a region of the same fluid, which, apart from the influence of the jet, is at rest and at a uniform temperature is studied. A buoyancy force arises as a result of the difference in temperature between the jet and the surrounding fluid. The jet is considered to arise from fluid issuing under pressure from a small circular hole or a narrow slit in the wall. Assuming the flow to be steady, viscous, and laminar similarity methods are used to solve the boundary layer equations and hence to determine the velocity and temperature distributions in the two-dimensional as well as the axially symmetric heated jet. Dissert. Abstr.

N68-20752# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
VISCOUS REGION OF TURBULENT BOUNDARY LAYER
Henry W. Tieleman Dec. 1967 240 p refs
(Contract DA-AMC-28-043-65-G20)
(CER67-68HWT21; AD-665393)

The nature of mean and turbulent motion in the viscous sublayer of a thick boundary layer with zero pressure gradient was investigated. Measurements were made of the mean motion, two of the turbulent velocity components, the turbulent shear stress, and spectra of the longitudinal component of the velocity fluctuation. Traverses were made through approximately one-fifth of the boundary layer, which was approximately 32 inches thick. The boundary layer was developed along the floor of the wind tunnel test section for 85 feet. The turbulent shear stresses and the turbulence intensities were evaluated from a single rotated wire. A detailed account is given of the theory concerning the yawed wire operation. Included are corrections for the results from normal and yawed hot wires when operated in large mean velocity gradients and/or turbulence intensity gradients. Author (TAB)

N68-20758# Boeing Scientific Research Labs., Seattle, Wash.
PRESSURE OSCILLATIONS PRODUCED IN A WIND TUNNEL BY HINGED PLATES IN THE WALLS OF THE TEST SECTION
F. Edward Ehlers Jan. 1968 28 p refs *Its* Math. Note No. 547
(D1-82-0703; AD-665723)

For a study of the feasibility of producing suitable pressure oscillations in a supersonic wind tunnel for testing inlets under gust conditions, the linearized partial differential equation for the perturbation velocity potential was solved for the unsteady flow downstream of oscillating wind tunnel walls. The boundary conditions were satisfied on the mean position of the walls which were assumed to be rotating sinusoidally through small angles about the upstream edges. The amplitude of the pressure and density oscillations in the test rhombus was computed for several values of the reduced frequency, defined by the product of the angular frequency of oscillation and of the time for the fluid to travel a distance equal to one half the wind tunnel height. The pressure amplitude was found to be fairly uniform in the test section when the reduced frequency was less than about 1/4 at a free stream Mach number of 2.4. For larger values of the reduced frequency, the pressure amplitude varied throughout the test rhombus, the degree of variation increasing with the reduced frequency. Author (TAB)

N68-20777 North Carolina State Coll., Raleigh.
ON TRANSITION FROM SUPERSONIC TO SUBSONIC FLOW IN A TUBE AT LOW REYNOLDS NUMBERS
Rong-yaw Chen (Ph.D. Thesis) 1966 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5674

A supersonic low-density gas stream being produced with a supersonic nozzle at several different stagnation chamber pressures was passed through a circular tube in which the transition from supersonic to subsonic flow took place. Static pressure distributions, impact pressure profiles, and true Mach number profiles are presented. Velocity and temperature profiles were calculated from the true Mach number profiles and are graphed. The range of centerline Mach number in the tube (and downstream of the nozzle) was from 0.25 to 2.61, while the range of Reynolds number (based on center-line conditions and local diameter) was from 26 to 1580. Wall static pressure increases in the region near the tube inlet and then decreases. The Mach number along the center-line decreases very rapidly and then increases rather slowly. The ratios of the average stagnation pressure to the inlet stagnation pressure of the nozzle were very small due to the large viscous losses. A very weak shock near the center-line and velocity slip at wall were observed. Dissert. Abstr.

N68-20796# Boeing Scientific Research Labs., Seattle, Wash.
THE EFFECT OF ACCELERATION ON A SPHERE FILLED WITH A COMPRESSIBLE, INVISCID LIQUID
F. E. Ehlers Oct. 1967 28 p refs *Its* Math. Note No. 544
(D1-82-0682; AD-665709)

To study the effect of large acceleration on a fluid filled sphere, the equations of motion of a compressible non-viscous fluid, expressed in spherical coordinates with axial symmetry, were linearized under the assumption of small perturbations from rest. The equations were solved for the flow in a sphere which is suddenly accelerated from rest at constant value of the acceleration. Line of constant density and pressure were calculated for the sphere at several values of the time, and the streamlines were sketched by the method of isoclines. All the streamlines pass through the stagnation points located on the surface of the sphere at the ends of that diameter which is parallel to the acceleration. The maximum pressure in the sphere is about equal to the hydrostatic value at a depth equal to the diameter for a fluid in a steady state gravitational field defined by the magnitude of the acceleration and occurs at the base of this diameter, while the minimum pressure occurs at the opposite end. By means of the convolution integral, the pressure on the inside surface of the sphere being accelerated sinusoidally was computed. The reaction force produced by the motion of the fluid against the driving acceleration was also calculated. Author (TAB)

N68-20833# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
AN EXPERIMENTAL INVESTIGATION OF SHOCK WAVE-BUBBLE INTERACTION AND REFLECTION HOLOGRAMS OF LONG POLYMER MOLECULES Final Report
Albert T. Ellis, William P. Gruber, and Nicholas George Jan. 1968 40 p refs
(Contract Nonr-220(44))
(E-115-A.1; AD-665678)

A preliminary experimental study was made to determine the behavior of an air bubble subsequent to the impingement of a shock wave or sharp pressure front upon it. An observed feature of the motion is the formation of a liquid jet similar to those created during the detonation of a shaped explosive charge. Two types of bubbles were observed. One is a long air bubble rising in a shock tube partially filled with water. As first shown by G. I. Taylor the upper interface is nearly spherical. The other is a nearly spherical bubble. Jets are observed in both cases and therefore indicate the need to consider this phenomenon in cavitation damage and cavitation hysteresis studies. In view of the significant effects of very dilute solutions of long chain molecules on cavitation, work on a short pulse duration argon laser was done which shows promise as a means of obtaining holographic information on the dynamic behavior of these molecular groups. Operating pressure of the argon gas is found to be important for short optical pulse generation. Methods of obtaining the holograms pertinent to this application are discussed. Author (TAB)

N68-20860*# Case Western Reserve Univ., Cleveland, Ohio.
TRANSPORT PHENOMENA OF GENERAL NON-EQUILIBRIUM GAS SYSTEMS
Eddie L. Walker Jun. 1967 173 p refs
(Grant NsG-198)
(NASA-CR-93918; A-51) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The theory of gas mixtures is extended to cases where there may be large differences in the flow velocities and/or temperatures of the species in the mixture. Transfer equations for the thirteen moments of each species are constructed relative to the species' flow velocity; the equations are closed by means of the Grad approximate velocity-space solution for the species' distribution functions. The partial collision integrals occurring in the transfer equations are then expressed as functions of a dimensionless velocity. The integrals are evaluated for two limiting cases: arbitrary isotropic collision cross sections, and arbitrary inverse power interparticle force laws. A final set of exact calculations is made for the "Maxwell molecule" force law. Various statistical collision models are next presented as possible substitutes for the Boltzmann binary collision operator, with a view towards duplicating the partial collision integrals of that operator. Finally, transport quantities are calculated for: weakly ionized gases, binary Maxwell molecular gases, and for fully ionized gases. Author

N68-20888 Illinois Univ., Urbana.
ON THE TURBULENT MIXING OF SEMICONTAINED COMPRESSIBLE STREAMS AT CONSTANT PRESSURE AND SMALL RELATIVE FLOW ANGLES
Vernon Parker Roan, Jr. (Ph.D. Thesis) 1966 220 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-6714

An experimental and analytical investigation was conducted of the mixing region between two co-flowing turbulent, compressible streams in a confined space. The two streams were allowed to have small relative flow angles, various velocities, and various flow areas. One of the streams was supersonic and the other subsonic to simulate semicontained flow. The nozzles used to produce the supersonic flow were contoured using the method of characteristics in order to minimize the occurrence and the strength of any compression and expansion. Both streams were two-dimensional. A solution for the properties of the mixing region was obtained by modifying an Abramovich–Schlichting solution for semicontained incompressible flow and using a Howarth-type transformation to apply the incompressible solutions to the actual compressible flow. The solution included consideration of the small relative flow angle between the streams. Dissert. Abstr.

N68-20926# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
VORTICAL LAYERS IN SUPERSONIC CONICAL FLOW
R. E. Melnik Mar. 1968 24 p refs Presented at the AGARD Meeting on Hypersonic Boundary Layers and Flow Fields, London, 1–3 May 1968
(RE-323J)

The research discussed in this report deals with the problem of inviscid supersonic flow over slightly yawed conical surfaces. The cross section is assumed nearly circular but otherwise arbitrary. Previous solutions of this problem were not valid in the vicinity of the cone surface where a thin "vortical" layer of extremely high gradients of velocity, density and entropy are present. The present

research remedies this defect and a solution is given which is uniformly valid in the "vortical" layer. The nonanalytic behavior of the solution near the cone surface is analyzed and particular attention is given to the behavior near vortical singularities. There is no indication of the lift-off behavior of vortical singularities suggested by Ferri. Examples of entropy profiles for circular and elliptic cones are constructed from the basic theory. The present investigation points to the existence of a large vorticity interaction in the problem of viscous boundary layers on pointed bodies at angle of attack and the need to study its effect on heat transfer and skin friction. Author

N68-20984# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

APPROXIMATE METHOD FOR MULTIDIMENSIONAL DIFFUSION THEORY PROBLEM

K. F. Hansen and S. R. Johnson 18 May 1967 43 p refs
(Contract AT(04-3)-167)
(GA-7544) CFSTI: HC $3.00/MF $0.65

An approximate method for solving the multidimensional diffusion theory problem is presented. The method involves expanding the flux function by polynomial expansion in three-dimensions. Coupling of separate regions is made through leakage currents only. The spatial shapes of the leakage currents are then calculated analytically. The method of solution is detailed. The GORST computer program, which is a result of this theoretical work, is discussed. Input format, sample input, and program listing are given. NSA

N68-21008# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

FLOW-RATE AND PRESSURE COEFFICIENTS ON THE SURFACE OF A CONICAL FLOW AT HYPERSONIC VELOCITIES

A. M. Mkhitaryan and M. P. Ovsyannikov 25 Jan. 1968 8 p refs Transl. into ENGLISH from Izv. Vyssh. Zaved., Aviats. Tekh. (Kazan), v. 10, no. 1, 1967
(Contract NOw-62-0604-c)
(APL-TG-230-T541; AD-665596)

Presented in the brief note is an approximate determination of the flow-rate and pressure coefficients for a symmetrical hypersonic flow past a circular cone. Approximate formulas are given for both coefficients. The analytical results for a cone semi-apex angle of theta > 10 deg. and M > 3.5 are in good agreement with the exact values of the coefficients as calculated from tables for conical flows. Author (TAB)

N68-21009# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

METHOD OF INTEGRAL RELATIONS IN THE THEORY OF TURBULENT JET STREAMS

A. S. Ginevskii 12 Dec. 1967 51 p refs Transl. into ENGLISH from Prom. Aerodinamika (USSR), no. 27, 1966 p 5–30
(Contract NOw-62-0604-C)
(APL-TG-230-T-537; AD-665592)

On the basis of Karmans and Leibensohns integral relations, a solution is given for problems of the initial and main sections of plane and axisymmetric isothermal turbulent jets in a wake flow for the general case when the nozzle exhaust velocity of a fluid is either greater or smaller than the wake flow velocity. In addition, a solution is given for the problem of the initial and main sections of divergent and convergent radial-slot jets; a connection is established between the calculated formulas for such jets and a plane submerged jet, which follows from the well-known Stepanov-Mangler transformation. A brief discussion is given showing how to extend the above integral methods to a turbulent jet which is nonisothermal, compressible, and has variable properties. Author (TAB)

N68-21088# Atomics International, Canoga Park, Calif.

PNPF SINGLE ELEMENT (IPT FLOW) HYDRAULIC TEST REPORT

J. E. Arnold 8 Aug. 1967 23 p refs
(NAA-SR-MEMO-12536) CFSTI: HC $3.00/MF $0.65

Data obtained from the test program on the modified IPT outlet are given; the acceptability of the hydraulics associated with this design is discussed. Detailed analysis of the data and an analytical evaluation of the design will be included in a report now in preparation. Author (NSA)

N68-21101 North Carolina State Coll., Raleigh.

SIMILAR SOLUTIONS FOR VISCOUS COMPRESSIBLE LAMINAR FLOW IN SLENDER AXISYMMETRIC CHANNELS

John Cecil Adams, Jr. (Ph.D. Thesis) 1966 179 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-5672

This investigation consists of an analytical study of laminar, compressible flow of a perfect gas through an axisymmetric channel using the method of similar solutions. A similarity transformation of the governing equations of motion is developed which, along with the assumption of product type temperature and stream functions, allows a systematic study of the flow field for two different wall conditions, adiabatic and variable temperature. Solutions to the transformed equations of motion are found for both a diatomic gas (specific heat ratio of 1.400) and a monatomic gas (specific heat ratio of 1.667) over a range of centerline Mach numbers from 0.50 to 8.00 and various Prandtl numbers from 0.675 to 1.000 by application of a method which transforms a boundary value problem into an initial value problem. Dissert. Abstr.

N68-21106 Pennsylvania State Univ., University Park.

A STUDY OF THE EFFECTS OF ISOLATED PERMEABILITY INTERFERENCES ON THE SWEEP EFFICIENCY AND CONDUCTIVITY OF A FIVE-SPOT NETWORK

Rafael Juan Sandrea (Ph.D. Thesis) 1966 158 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-5958

It was the object of this study to consider the presence of rectilinear, impermeable and infinitely permeable interferences in an otherwise homogeneous five-spot pattern, and to analyze theoretically and experimentally their effects on the resulting sweep efficiency and pattern conductivity. The experimental study was conducted using two different models: the Hele–Shaw flow cell and the field plotter. A functional relationship was developed, based on a simplified theory, which provides the quantitatives prediction of the behavior of the above parameters, i.e., sweep efficiency and conductivity, in the nonhomogeneous system. In order to evaluate this, it is necessary only to measure the interference modulus of the obstacle using a simple expression. Dissert. Abstr.

N68-21149# California Univ., Livermore. Lawrence Radiation Lab.

SOME TIME-DEPENDENT SOLUTIONS FOR GAS-DYNAMIC FLOWS WITH MASS ADDITION AND FRICTION

Barbara K. Crowley 16 Nov. 1967 15 p refs
(Contract W-7405-ENG-48)
(UCRL-50352) CFSTI: HC $3.00/MF $0.65

Time-dependent solutions of the one-dimensional conservation equations are obtained for gas flows with mass addition and friction. To analytically integrate the conservation equations, the flows are considered uniform, without pressure or velocity gradients. Since $\partial U/\partial x = (1/V)(dV/dt)$ for a given element in one dimension, the absence of a velocity gradient implies a constant-volume flow. The solutions indicate that, with either friction or mass addition, both the velocity of flows and the change in velocity compared to the original velocity decrease inversely with time. The velocity thus approaches a nearly constant value, or apparent terminal velocity. When both friction and mass addition are present, velocity decreases

logarithmically with respect to time, and the apparent terminal velocity is approached sooner. It is hoped that if their time-dependent effects on constant-volume flows are illustrated, the presence of mass addition and friction in more complex flows may be better appreciated. Author (NSA)

N68-21155# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
THE MEASUREMENT, INTERPRETATION AND USE OF UNSTEADY MOMENTUM FLUXES IN TWO PHASE FLOW
Tien Sieh Yih and Peter Griffith Aug. 1967 35 p refs
(Contract AT(30-1)-3496)
(Rept.-70318-50; TID-24126) CFSTI: HC $3.00/MF $0.65

The steady and unsteady components of the momentum flux in a two-phase flow were measured at the exit of a vertical pipe by means of an impulse technique using a turning tee and beam. Different electrical filters have been tried in the recording circuit for eliminating the signals around the natural frequency of the beam system. A special filter set has been designed to approximate the inverse of the transfer function of the beam system. Thus the signals recorded after passing through the beam-filter combination can be considered as the excitation times a constant. Two different analog methods have been used to analyze the random signals for obtaining some statistical quantities such as the predominant frequency and the rms value of the unsteady momentum flux. These quantities are useful in some applications involving two-phase flow. In the preliminary measurements of the unsteady momentum flux for the adiabatic up flow of an air–water mixture in a 5/8 inch pipe, the greatest unsteadiness of momentum flux appeared in the quality range of one percent to six percent. Above ten percent quality no appreciable fluctuation has been detected. In an example problem, using the preliminary results, the effect of the unsteady momentum flux on a fuel rod has been studied. The amplitude of the vibrations resulting from the two-phase excitation has been found. In addition it has also been found that there is a possibility of unstable vibrations due to a nonlinear restoring force on the fuel element. This nonlinearity is due to the unsteady component of the momentum flux in the flow past the rod. Author (NSA)

N68-21200# Royal Aircraft Establishment, Farnborough (England).
MECHANICAL AND THERMAL EFFECTS OF CHEMICAL REACTIONS IN COMPRESSIBLE FLOWS
F. Wecken Nov. 1967 38 p refs
(RAE-LIB-TRANS-1261) CFSTI: $3.00

Following a discussion concerning different equations of state, particularly for chemically-reacting mixtures, the concept of thermal or energy effects is analyzed and a mechanical energy effect is defined. With its help, mechanical and thermal effects of reactions are described and clarified by means of examples. Observations are made regarding the conditions for the existence of stationary, plane transition fronts; general, non-steady laminar flows are discussed and from these certain conclusions are drawn when a sonic limit is involved. The investigation is related specifically to detonation processes and supersonic flows. Author

N68-21220# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Berlin (West Germany). Institut fuer Turbulenzforschung.
INVESTIGATION OF THE TWO-DIMENSIONAL TURBULENT BOUNDARY-LAYER IN A ROTATING SYSTEM [MESSUNGEN IN DER EBENEN TURBULENTEN GRENZSCHICHT IM ROTIERENDEN SYSTEM]
Uwe Anders Feb. 1968 90 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-07; DVL-702) CFSTI: HC $3.00/MF $0.65

The two-dimensional turbulent boundary-layer at the walls of three different rotating channels is investigated. The momentum integral equations given by several authors are examined, two new momentum integral equations are derived. To solve the momentum integral equation one needs empirical laws for the wall shear stress and the form of the velocity profiles. By means of the experimental results it is shown that the wall shear stress and the form of the velocity profiles are closely approximated by equations which are known from the non-rotating turbulent boundary-layer with adverse pressure gradient. To this purpose it is necessary to define a displacement thickness and a momentum thickness in a form suitable to the conditions in a rotating system. Author

N68-21253# Brown Univ., Providence, R. I. Div. of Engineering.
LAMINAR BOUNDARY LAYER CONTROL BY COMBINED BLOWING AND SUCTION IN THE PRESENCE OF ROUGHNESS
G. F. Anderson (Southeastern Mass. Technol. Inst.), S. P. Sutera, and V. S. Murthy Oct. 1967 73 p refs Prepared for Pa. State Univ.
(Contract NOw-65-0123)
(WT-51; AD-666569)

The feasibility of maintaining a fully laminar boundary layer on a given two-dimensional body by means of combined blowing and suction and the effectiveness of blowing for increasing the boundary layers tolerance to roughness are investigated theoretically. The potential flow past the body is determined by using a suitably selected source distribution and then refining the body obtained from this selection by means of slender body techniques. The boundary-layer calculations are then made for various blowing rates at the stagnation point. The calculations indicate that the combination of suction, applied to maintain a laminar boundary layer, and blowing near the stagnation point, to improve the tolerance of the laminar boundary to roughness, can substantially reduce the skin friction of bodies operating at high Reynolds numbers. Author (TAB)

N68-21262# UniRoyal Research Center, Wayne, N. J.
FLOW PROPERTIES OF DILUTE SOLUTIONS OF POLYMERS. PART 3: EFFECT OF SOLUTE ON TURBULENT FIELD Final Report
Fitzhugh W. Boggs and John Thompsen Dec. 1967 47 p refs
(Contracts Nonr-3120(00); N00014-66-C-0322)
(AD-666581)

The equations for the turbulent fluctuations in a second order fluid were examined. They are markedly different from those which can be derived from the Navier-Stokes equation. The linear terms show characteristic relaxation effects. The quadratic terms include not only the Reynolds stress tensor but higher derivatives of its not only the Reynolds stress tensor but higher derivatives of it as well as other quadratic terms. These terms change the relation between the velocity fluctuation and the pressure fluctuation; they also change the velocity fluctuations. Strong damping of vortices close to the wall having axes in the direction of the flow is a conspicuous characteristic of these flows. Author (TAB)

N68-21303# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
OPTICAL MEASUREMENT OF RADIAL DENSITY DISTRIBUTIONS IN A HIGH SPEED CONFINED AIR VORTEX
George Gyarmathy Dec. 1967 122 p refs
(ARL-67-0234; AD-666460)

An optical method based on light-deflection mapping was developed and used to determine the radial variation of fluid density in a high-pressure-ratio (20:1), high-speed, confined air vortex of about 3 inches diameter. An intense, parallel, thin light beam was transmitted laterally through the vortex at various off-axis positions, and the small light deflections caused by the density field of the vortex were measured. From the variation of the deflection angle over the radius, the radial density profile was numerically calculated by assuming rotational symmetry and solving the resulting integral equation. The density profile was determined in two cross-sections of the vortex, at various operating conditions of the chamber. The results show that the core region in which

the fluid rotates like a solid body has a very uniform diameter corresponding to about half of the exhaust port diameter. The presence of axial density differences, which are related to the meridional flow movements, is clearly shown. In a further experiment, the disturbance of the density profile caused by a static-pressure probe was determined for various radial penetrations of the probe. Besides acoustic resonance a considerable density fluctuation was observed, especially at radii smaller than that of the exhaust opening. This finding indicates the existence of periodic fluctuations in the rotational speed of the vortex. Author (TAB)

N68-21323# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

LOW DENSITY HIGH TEMPERATURE GAS DYNAMICS Final Scientific Report, 1 Nov. 1966–31 Oct. 1967

Jean J. Smolderen 31 Oct. 1967 16 p refs

(Grant AF-EOAR-67-10)

(AFOSR-68-0463; AD-666474)

Preliminary experiments to test the feasibility of measuring directly the difference between a free molecule and a near free molecule effect were successfully carried out. The magnitude of the correction was found to be inversely proportional to the free stream Knudsen number and asymptotically approached zero as the Knudsen number became large compared to one. The drag coefficients of a sphere and a cylinder in the hypersonic, near free molecule regime were accurately measured with a modulated force probe. The results exhibit considerably less scatter than previously obtained by other experimenters. Qualitatively correct measurements of the local mass flux and speed ratio in a hypersonic rarefied free jet were carried out with a modulated cold wire probe presently under development. Heat transfer rates to small flat surfaces at varying angles of incidence in an arc heated, hypersonic, rarefied flow indicate that the thermal accommodation coefficient decreased with decreasing angle of incidence. An analytical study of the gas-surface interaction problem was carried out using a modified Baule model. Author (TAB)

N68-21365*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AN EXPERIMENTAL STUDY OF LIQUID FLOW INTO A BAFFLED SPHERICAL TANK DURING WEIGHTLESSNESS

Charles R. Andracchio and Kaleel L. Abdalla Washington Apr. 1968 23 p refs

(NASA-TM-X-1526) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Liquid flow into a baffled spherical tank during weightlessness was investigated. A sphere within a sphere configuration was tested using a partially wetting liquid and a totally wetting liquid while varying the percent initial filling in the tank. Both liquids can be pumped into the tank over a range of velocities which maintains the liquid-vapor interface in a stable orientation; the maximum value of these velocities is a function of initial liquid filling in the tank. A baffled tank allowed higher stable filling rates than an unbaffled tank; similarly, the partially wetting liquid allowed higher stable filling rates than the totally wetting liquid. The use of a deflector mounted on the baffle improved the stable filling rate of the totally wetting liquid at low initial fillings. Author

N68-21411# RAND Corp., Santa Monica, Calif.

TOROIDAL AND POLOIDAL FIELD REPRESENTATION FOR CONVECTIVE FLOW WITHIN A SPHERE

Michael Sherman Feb. 1968 46 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5581-PR; AD-666019)

A method for determining the onset of convection in a fluid confined within a sphere and heated from below. The velocity field is analyzed in terms of toroidal and poloidal fields, expressed in spherical Bessel functions and spherical harmonics, which have certain orthogonality properties that are useful in treating convective flow problems within spheres. The utility of this representation is demonstrated by considering the stability of a nonuniformly heated fluid in a spherical cavity. A variational principle is presented, equivalent to the eigenvalue problem for the critical Rayleigh number (the stability criterion). This principle forms the basis for an approximate method of determining upper bounds to the critical Rayleigh number. It is found that a class of three-dimensional disturbances is more unstable than either the simplest poloidal (axisymmetric) disturbance mode or the simplest toroidal (two-dimensional) disturbance mode. The numerical results are compared with previously published analyses. Author (TAB)

N68-21455# Forest Products Lab., Madison, Wis.

EXPERIMENTAL RESEARCH OF CONDENSATION OF THE STREAM OF STEAM IN A SPACE FILLED OUT BY A LIQUID

B. F. Glikman Jul. 1961 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Energ. i Transport (Moscow), no. 1, 1959 p 39–44

(FPL-TRANS-441; PB-176503T) CFSTI: HC $3.00/MF $0.65

Experiments were conducted on the condensation of steam in water in a transparent plexiglass reservoir. The steam entered the reservoir through either a flat or round nozzle. Data were obtained on the velocity, pressure, and temperature fields in different cross sections of the stream. Visual observations showed that the stream condenses near the nozzle and the space of condensation is surrounded by a nontransparent conus from the vesicles. The experimental method is described, and the results are shown graphically and compared with theoretical results. R.N.A.

N68-21698# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

AN EXPERIMENTAL INVESTIGATION OF HYPERSONIC FLOW AROUND A SLENDER CONE

Edward M. Schmidt and Robert J. Cresci Oct. 1967 44 p refs

(Contract Nonr-839(38); ARPA Order 529; Proj. Defender)

(PIBAL-1031; AD-666117)

The paper presents the results of an experimental survey of the flow field around a sharp, 10 degree half angle cone. Tests were conducted at a free stream Mach number of 7.7 for a range of free stream Reynolds numbers of 110,000 to 171,000 per foot. Surface heat transfer data indicates that the cone boundary layer varies from laminar to fully developed turbulent over this Reynolds number range. The base pressure variation was also obtained throughout this range of Reynolds numbers; from this, the interrelation between the surface boundary layer properties and the base pressure is discussed. A series of tests were conducted in the near wake region at two different values of free stream Reynolds number, i.e., 330,000 and 1,650,000 per foot, corresponding to a completely laminar and fully developed turbulent surface boundary layer at the cone shoulder, respectively. The relationship between boundary layer properties and near wake properties is studied. Author (TAB)

N68-21707# Aeronautical Research Council (Gt. Brit.).

COMPUTER CALCULATIONS OF RELAXATION REGIONS AND EQUILIBRIUM CONDITIONS FOR SHOCK WAVES WITH TABLES FOR CO_2 AND N_2O

T. Rees London HMSO 1968 11 p refs Supersedes ARC-27581

(ARC-R&M-3472; ARC-27581) HMSO: 5s 6d

Computer programs based on the Rayleigh-line method for the analysis of vibrational relaxation regions in shock waves have been used to deal with experimental data for CO_2 and N_2O. Author (ESRO)

N68-21721# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.

TIP CLEARANCE PROBLEMS IN AXIAL COMPRESSORS: A SURVEY OF AVAILABLE LITERATURE

John A. Reeder 4 Jan. 1968 62 p refs
(Contract W-7405-ENG-26)
(K-1682) CFSTI: HC $3.00/MF $0.65

A literature survey of the problems of tip clearances in axial compressors was made. No attempt was made to weave the various reports surveyed into a general theory. An attempt to bring into focus the salient features of all the surveyed investigations was made. This survey represents most of the investigations that were reported in the open literature up to the middle of 1966. Author (NSA)

N68-21724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VISCOSITY OF GAS MIXTURES
Richard S. Brokaw Washington Apr. 1968 27 p refs
(NASA-TN-D-4496) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An approximate method is developed for predicting the viscosities of mixtures involving both nonpolar and polar gases. For nonpolar mixtures, only the viscosities and molecular weights of the constituents are required, in addition to the mixture composition. With polar gases, dipole moments, boiling points, and boiling-point densities are also needed. The method is tested by comparison with experimental data on 25 gas pairs comprising 280 mixtures. The average error is 0.7 percent; the maximum error is 3.7 percent. (Errors may be much larger if this method is used for gas mixtures involving ions, free radicals, or valence-unsaturated atoms.) Author

N68-21745# Sandia Corp., Albuquerque, N. Mex.
ON THE FORM ASSUMED BY THE MOVEMENT EQUATIONS OF FLUIDS WHEN TAKEN INTO ACCOUNT THE CAPILLARY FORCES CAUSED BY VARIATIONS OF DENSITY WHICH ARE CONSIDERABLE BUT CONTINUOUS, AND ON THE THEORY OF CAPILLARITY IN THE HYPOTHESIS OF A CONTINUOUS VARIATION OF DENSITY [SUR LA FORME QUE PRENNENT LES EQUATIONS DU MOUVEMENT DES FLUIDES SI L'ON TIENT COMPTE DES FORCES CAPILLAIRES CAUSEES PAR DES VARIATIONS DES DENSITE CONSIDERABLES MAIS CONTINUES, ET SUR LA THEORIE DE LA CAPILLARITE DANS L'HYPOTHESE D'UNE VARIATION CONTINUE DE LA DENSITE]
D. J. Korteweg 4 Dec. 1967 28 p Transl. into ENGLISH from Arch. Neerl. Sci. Exactes Naturelles (Netherlands), v. 6, ser. 2, 1901 p 1–24
(SC-T-67-0956) CFSTI: HC $3.00/MF $0.65

Movement equations of fluids are developed in the case of a very thin capillary layer acting as a boundary. E.J.S.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-20717# Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.
THE SPECTRAL CHARACTERISTICS AND THE PROPAGATION IN THE MAGNETOSPHERE OF HYDROMAGNETIC EMISSIONS (PEARLS)
William R. Sill (Ph.D. Thesis) Dec. 1967 188 p refs
(AD-665775)

Many of the observed characteristics of hydromagnetic emissions or pearls have been successfully explained by the propagation of the guided Alfven wave along geomagnetic lines of force. This thesis extends some of the previous work, which has concentrated on the dispersion properties of these signals, by examining the fine structure in the spectral character of these signals. These emissions all show a very dramatic spectral feature of a series of high Q peaks. This frequency structure is present in the individual dispersed wave trains, and should not be confused with the fine structure obtained in a Fourier analysis of a series of repetitive signals. It is shown that the spectral peaks that are observed are consistent with the high order field line resonances that would be expected from models which satisfy the observed dispersion. The mode numbers are so high, being of the order 20 to 50, that one cannot expect to predict the actual frequencies observed. The observed separations between the peaks are in good agreement with those predicted from the model studies. An interpretation is proposed that the emissions are produced by the cyclotron resonance amplification of a background wave spectrum of resonant field line oscillations. Author (TAB)

N68-20751# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
DYNAMICAL RESPONSE OF THE THERMOSPHERE TO IMPULSIVE HEATING
Gary E. Thomas and Barbara K. Ching Jan. 1968 90 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-10)-5; SAMSO-TR-68-57; AD-665882)

The response of the upper atmosphere to general types of impulsive heat sources is calculated by use of analytic solutions of the heat conduction equation of Thomas (1967). It is found that time-lags of the maximum temperature and density are distinctly different and are strongly dependent upon altitude. This contrasts with satellite drag measurements of the density time-lag following sudden increases in the geomagnetic field, which indicate no appreciable altitude-dependence. The relationship between the energy q injected into the atmosphere and the geomagnetic disturbance index alpha sub p is shown to be very closely q oc the square root of alpha sub p over the entire range of disturbances. The results indicate that the heating producing the geomagnetic effect is considerably more complex than generally expected. However, the simple relationship q oc the square root of alpha sub p suggests a common heating mechanism that is present at all levels of activity. Author (TAB)

N68-20830# Ballistic Research Labs., Aberdeen Proving Ground, Md.
MEASUREMENT OF THE REFRACTIVE INDEX STRUCTURE COEFFICIENT C_n
Neal J. Wright and Ronald J. Schutz Dec. 1967 24 p refs
(BRL-MR-1885; AD-665371)

The refractive index structure coefficient, Cn, is an important parameter for optical propagation in the atmosphere. A theoretical discussion of structure functions is presented to show the origin of the refractive index and temperature structure functions. The equipment used to measure fluctuations in the atmosphere is discussed, and the calculation of the refractive index structure coefficient from these thermal measurements is shown. The details of the experimental evaluation of Cn and the results of Cn calculations are also included. Author (TAB)

N68-20881# Washington Univ., Seattle. Atmospheric Sciences Dept.
[DEPARTMENT OF ATMOSPHERIC SCIENCES ANNUAL REPORT, 1 DECEMBER 1966–30 NOVEMBER 1967]
Norbert Untersteiner et al 1 Dec. 1967 33 p refs
(Contract Nonr-477(24))
(AR-7; AD-665762)

The report covers activities during the period 1 December 1966 to 30 November 1967, at the Department of Atmospheric Sciences, University of Washington, at Drifting Station T-3, and at the Naval Arctic Research Laboratory, Barrow, Alaska. Autumn

1967 marked a change in the general conduct of the project. Both the micrometeorology and atmospheric chemistry programs had been maintained continuously for five years and it was felt that the accumulated data are now sufficient to establish a basic radiation climatology as well as the main features and trends of the carbon dioxide and ozone concentrations in the atmosphere. Current activities are concentrated on data analysis and interpretation, and on the solution of certain, specific problems such as the response of large sheets of sea ice to climate changes, the principles of radiation scattering in clouds, ice, and snow, and the diffusion of carbon dioxide across the sea surface. Author (TAB)

N68-20868# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.
SPATIAL ORDER IN FLUVIAL SYSTEMS: HORTON'S LAWS DERIVED FROM MIXED HEXAGONAL HIERARCHIES OF DRAINAGE BASIN AREAS
Michael J. Woldenberg 14 Feb. 1968 38 p refs *Its* "Geograph. and the Properties of Surface" Ser. Paper No. 13
(Contract N00014-67-A-0298-0004)
(TR-13; AD-665313)

The paper will show that the number of drainage basins in a fluvial system developed on a homogeneous surface is predictable, or explainable. The explanation of the numbers of basins is derived from a hexagonal model. In fact the model is exactly the same one used to predict the numbers of market areas per order in a system of central places, i.e. the cumulation of the numbers of towns of order u, and all higher orders. (Woldenberg, 1968). The paper will suggest that the equilibrium state in fluvial systems reflects a combination of least work and maximum possible entropy. TAB

N68-20876# Illinois Univ., Urbana. Electrical Engineering Research Lab.
IONOSPHERIC RESEARCH Final Report, 12 Sep. 1963–30 Sep. 1967
H. D. Webb Ft. Monmouth, N. J. Army Electron. Command Nov. 1967 36 p
(Contract DA-36-039-AMC-03703(E))
(QPR-16; AD-665351)

Moon-reflected signals 150.6 MHz were received on 31 days for approximately 273 hours during the period July 1, 1967 to September 30, 1967. In addition, signals at 413.25 were received for approximately 52 hours. The 150.6 MHz signals were received on 606 days for 5203 hours from September 12, 1963 to September 30, 1967. The strip charts have been read out, and corrected Faraday rotation and total columnar electron content have been plotted for all of the days of operation. These results are available in Atlas form for all of the days of operation through 1966. The data for all days of operation in 1967 have been machine plotted. Seasonal averages are presented for late 1966 data and for all of the 1967 data through September 1967. These averages indicate the marked increase due to increased solar activity and the lower summer time level. Author (TAB)

N68-20889 New York Univ., N. Y.
ON THE MEASUREMENT OF THE DIRECTIONAL SPECTRA OF WIND GENERATED WAVES USING A LINEAR ARRAY OF SURFACE ELEVATION DETECTORS
Raymond G. Stevens (Ph.D. Thesis) 1966 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-6054

Wind generated waves, the disturbance produced by the action of the wind blowing over the water, may be described in terms of the distribution of energy amongst various sinusoidal components having different frequencies and different directions of propagation. However, a numerical method was developed with which the functions of directional selection and frequency filtering may be performed using a digital computer. This directional information can be obtained from a stationary linear array of surface elevation detectors. The results of a few observations taken in Buzzards Bay, Massachusetts are examined to demonstrate the internal consistency of the instrument system. These preliminary observations indicate that the directional distribution of spectral energy is neither smoothly distributed nor is it a maximum in the direction of the wind. It is concluded that further investigation is required before this effect can be interpreted physically. Dissert. Abstr.

N68-21007# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
MULTI-MODE WAVE COUPLING IN INHOMOGENEOUS, ANISOTROPIC MEDIA—WITH SOME MAGNETOIONIC APPLICATIONS
O. E. H. Rydbeck 10 Apr. 1967 304 p refs
(Contract AF 19(628)-4014; Grant NSF GP-5611)
(AFCRL-68-0067; SR-295; AD-665875)

The report deals with coupled waves, or coupled modes in arbitrary inhomogeneous n-wave systems. The partial waves, which make up the total wave field (of some physical kind) are expressed either in terms of so called inhomogeneous wave numbers, or of regular homogeneous ones (with corresponding phase integrals). The partial wave amplitudes are related to each other by first order coupled amplitude equations, with coupling coefficients depending upon the physical nature of the modes appearing in the system. These wave couplings are formally simple only when the partial waves have symmetrical properties of some kind (which is the case in many practical applications). A great number of coupled mode systems are analysed, compared, and discussed in considerable detail, with applications for example to magnetoionic, and to active (amplifying), inhomogeneous media. This report represents a major effort to relate all coupled wave phenomena to each other, irrespective of their particular physical background; in short to present a unified theory of multi-mode couplings in inhomogeneous media. Author (TAB)

N68-21020# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.
ATMOSPHERIC PROPAGATION Summary Report, 1 Oct. 1966–30 Sep. 1967
Ivan Tolstoy, T. Herron, and D. W. Kraft 2 Oct. 1967 61 p refs
(Contract Nonr-266(84))
(CU-170-67-ONR-266-Phys.; TR-144; AD-665677)

The report summarizes the work performed during FY 1967. After a brief description of the system and its characteristics, a number of background studies are described. Particular attention has been given to microbarographic pressure fluctuation levels (power spectra) and cross-spectral properties such as coherence and phase lags between pairs of instruments. It is found that an important fraction of the background, in the 5 to 50 min period range, consists of slowly traveling disturbances (20-40 m/sec) probably associated with the jet stream. This part of the background is coherent over distances of a few km, and decorrelates rapidly for distances greater than 10 km. This report also discusses briefly immediate plans for FY 1968. Author (TAB)

N68-21132# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE MOUNTAIN IRON DIFFUSION PROGRAM, PHASE 1. SOUTH VANDENBERG, VOLUME 1
W. T. Hinds and P. W. Nickola Vandenberg AFB, Calif. AF Western Test Range Nov. 1967 220 p refs
(Contract AT(45-1)-1830)
(BNWL-572, V. 1; AFWTR-TR-67-1) CFSTI: HC $3.00/MF $0.65

Field diffusion experiments were conducted at Vandenberg Air Force Base, California, during 1965 and 1966. This program, nicknamed "Mountain Iron," was undertaken to establish quantitative diffusion predictions for use as range safety tools in the "South Vandenberg" ballistic and space vehicle operations. The only

pollutant source character studied was toxic propellant materials released continuously from ground level pools. The operational applications and limitations of the equations and other results obtained are described. NSA

N68-21165# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.

ATMOSPHERIC DIFFUSION OF PARTICULATE MATTER RELEASED FROM AN ELEVATED CONTINUOUS SOURCE

Robert E. Stewart 1967 22 p refs Presented at the 60th Ann. Meeting of the Air Pollution Control Assoc., Cleveland, 11–16 Jun. 1967 Submitted for publication

(PB-176840) CFSTI: HC$3.00/MF$0.65

Dustfall experiments were conducted to estimate the ground-level deposition pattern. Different size batches of glass microspheres (50 to 200 microns) were continuously released into the atmosphere from an elevated point source. Samples were placed at ground-level along arcs downwind from the stack and the particles were subsequently identified and counted. Measurements of wind speed, gustiness, and temperature gradient were made. The data were compared with theory. Two mathematical models were used in the comparison: a three-dimensional classical model by Densiov (comparable to Rounds's two-dimensional solution), and a three-dimensional statistical model by Csanady. Both models assume steady-state conditions, horizontal homogeneity, linear growth relationships for the plume dimensions, and complete particle retention at the ground. It was found that the deposit pattern can be predicted resonably well by the statistical model but should be restricted to values of f/u and f/sigma sub w (u is the mean wind speed; f is the particle terminal velocity, and sigma sub w is the rms value of the vertical velocity fluctuations of the turbulent field) greater than 0.05 and 1.0 respectively. At lower values of these ratios, the statistical model overestimates the maximum deposition and underestimates its location. The classical model, in general, underestimates the maximum deposition by a factor of approximately 1.5. Author

N68-21189# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

UTILIZATION OF ELECTRONIC COMPUTERS IN THE INTERPRETATION OF AEROMAGNETIC SURVEYS [OPYT ISPOL'ZOVANIYA ELEKTRONNYKH VYCHISLITEL NYKH MASHIN PRI INTERPRETATSII REZUL'TATOV AEROMAGNITNYKH S'YEMOK]

O. M. Frolova Dec. 1967 20 p refs Transl. into ENGLISH from Zhizn Zemli (Moscow), no. 3, 1965 p 174–182

(ACIC-TC-1287; AD-665201)

Almost the entire territory of the Soviet Union is covered by aeromagnetic and gravity surveys. Special attention is given to the study of separate structural peculiarities of the terrestrial crust. The problem of the abyssal structure of the earths crust is most important at present. The Strela-2 electronic computer at Moscow State University was used to interpret the aeromagnetic data. In this study, the problems of programming on the example of some formulas used in prospecting geophysics are briefly discussed. Also, some conclusions are given on the possibilities of utilization of electronic computers in the interpretation of geophysical data. TAB

N68-21247 International Consultant Scientists Corp., Brookline, Mass.

ELECTROHYDRODYNAMICS—THE TORNADO SIGNAL [ELECTROHYDRODYNAMIQUE—LE SIGNAL DE LA TROMBE]

John Carstoiu [1968] 5 p refs In FRENCH

The view is offered that the earth or the sea exerts a certain influence on clouds in an unstable state of equilibrium, and that these clouds are sensitive to all perturbations they encounter. Therefore, a very small local irregularity of the terrestrial magnetic field initiates the lowering of a cloud strongly charged with electricity. The cloud is then put into a spinning regime, complicated by the presence of electromagnetic forces. A formula is presented to define the density of the magnetic field in terms of the density of the magnetic charge and the magnetic conductivity. The tornado signal is compared with the water source signal, and a theory is proposed that the tornado is set in motion by a magnetism built up in the clouds. Transl. by M.G.J.

N68-21264# Commissariat a l'Energie Atomique, la Hague (France). Group de Radioecologie Marine.

DETERMINATION OF THE RUTHENIUM, CERIUM, AND ZIRCONIUM RADIOACTIVITY OF SEA-WATER BY CARRYING-OVER AND ADSORPTION USING MANGANESE DIOXIDE [DETERMINATION DE LA RADIOACTIVITE DE L'EAU DE MER EN RUTHENIUM, CERIUM, ZIRCONIUM PAR ENTRAINEMENT ET ADSORPTION AU MOYEN DU BIOXYDE DE MANGANESE]

Pierre Gueguniat Jul. 1967 29 p refs In FRENCH

(CEA-R-3284; SREc/H/67-104)

Manganese dioxide is precipitated in the medium to be analyzed by the action of hydrogen peroxide on potassium permanganate. Large volumes of seawater are treated by successive adsorptions of 80 liter fractions always using the same precipitate obtained from 30 g of potassium permanganate. Some examples are given concerning the analysis of 80, 160, 1000 and 2000 liters of water. The existence of low activities due to ruthenium, zirconium, and cerium can be demonstrated if sufficiently large volumes of water are treated. Author (NSA)

N68-21274# Bhabha Atomic Research Centre, Bombay (India).

CHARACTERISATION OF TROMBAY SOILS FOR DISPOSAL OF RADIOACTIVE WASTES

V. B. Godse, A. L. Mohan, Mahesh Singh, R. V. Amalraj, and K. T. Thomas 1967 23 p refs Presented at the IAEA/ENEA Symp. on the Disposal of Radioactive Wastes into the Ground, Vienna, 29 May–2 Jun. 1967

(BARC-297) CFSTI: HC$3.00/MF$0.65

The Bhabha Atomic Research Centre is situated on an island about 5 km east of Bombay island. Characterisation studies of the Trombay soils and ground water established the criteria for safe disposal of radioactive wastes. Physical and chemical properties of the soils were determined in order to evaluate their suitability for retention and leaching characteristics of radionuclides of interest. The soil covering consists of silty clay to clayey type of soil having a base exchange capacity of 34–76 meq/100 gm. The relative velocity factors for the radionuclides of interest have been evaluated in the laboratory with respect to ground water velocity of the area. Holes were bored in a grid pattern and field permeability was determined to find out the velocity of ground water in the area. Tracer experiments were also conducted for the rate and direction of ground water movement. An experimental study of direct discharge of solid waste from a chemical plant to the soil environment indicated that there was slight leaching of activity immediately after the monsoon. The general policy followed for ground disposal of radioactive wastes is to contain them in solid form with adequate monitoring and environmental surveillance. Author

N68-21276# Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 178

17 Apr. 1968 102 p refs

(JPRS-45076) CFSTI: HC$3.00/MF$0.65

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1. ASTRONOMY p 1–16 refs (See N68-21277 11-30)

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4. TERRESTRIAL GEOPHYSICS p 48–76 refs (See N68-21280 11-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 77–92 refs (See N68-21281 11-13)

N68-21279# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 178 17 Apr. 1968 p 42–47 refs (See N68-21276 11-13)

Summaries, abstracts of scientific articles, and book reviews from Sino-Soviet bloc publications are presented in the field of oceanography. Complete bibliographic data accompanies each article. Included are: news articles on the circumnavigation of Antarctica by the Soviet ship Ob, marine hydrological forecasts, and the measurement of turbulent diffusion in the oceans; a book review on the dynamics of the ice cover; and abstracts on the application of the Riemann problem in studying interactions between solar plasmas and the earth's geomagnetic field, the rapid variations in the intensity of magnetospheric high energy particles, the formation of water layers at the bottom of the Labrador sea, a method of compiling bathymetric charts, and spectra of the currents in the central part of the Black Sea. E.J.S.

N68-21280# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 178 17 Apr. 1968 p 48–76 refs (See N68-21276 11-13)

Summaries of news articles, book reviews, and abstracts of scientific articles in publications on terrestrial geophysics of the Sino-Soviet bloc are presented. Complete bibliographic data accompanies each article. News articles summarized include: a method for analyzing the structure of microseisms, a review of the physical structure and interior processes of the earth, gravimeter calibration techniques, exploratory boreholes, tectonics of the Turan platform, and a device for registering seismic signals. Books reviewed cover the theoretical principle of geochemical prospecting, and the causes of earthquakes. Abstracted are scientific articles on the effect of deep crustal structures under seismic stations, high frequency seismic disturbances in Antarctica, gravimetry techniques, forces of hydrodynamic friction in the underground part of pumps in superdeep wells, the principal types of geoelectric cross sections of permafrost in the course of a year, earth thermal characteristics, crustal structure in southwestern Tadzhikistan, cyclic frequency of geomagnetic storms, photographic triangulation, and marine gravity measurements during the ninth Antarctic expedition. E.J.S.

N68-21281# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 178 17 Apr. 1968 p 77–92 refs (See N68-21276 11-13)

News articles from Sino-Soviet bloc publications are summarized in the field of upper atmosphere and space research, and scientific articles in these areas are abstracted. Complete bibliographic data accompanies each article. Summarized are news articles on the standard algorithm for checking registry levels at cosmic ray stations, integrating electrometers for registering weak particle fluxes, a multichannel spectral analyzer for whistlers and VLF emissions, meteor phenomena in the earth's atmosphere, the shore effect and radiophysics of auroras. Articles abstracted include: an interpretation of oscillograms from atmospheric soundings, the probability of simultaneous detection of meteors by different stations, analogies between corpuscular and wave radiation in ionospheric effects, energy flux in the solar wind, the anisotropic stage of the cosmic ray burst of 23 February 1965, acceleration of heavy nuclei during solar cosmic ray generation, the ionization calorimeter onboard the Proton satellite, earth–moon trajectories, meteoritic composition, ionospheric chemistry, the motion of magnetized equatorial satellites in a circular orbit, and grid adjustment in cosmic triangulation. E.J.S.

N68-21318*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH RELATED TO MEASUREMENTS OF ATOMIC SPECIES IN THE EARTH'S UPPER ATMOSPHERE Quarterly Status Report
Bernard J. Wood 1 Mar. 1968 12 p refs
(Contract NASr-49(30); SRI Proj. 6682)
(NASA-CR-94083; QSR-3) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Kinetics and mechanisms associated with the interaction of oxygen atoms with solid surfaces were studied under conditions similar to those encountered in the upper atmosphere. Changes in oxygen atom concentration resulting from surface reaction and recombination were studied in an environment in which changes in both oxygen pressure and rate of producing oxygen atoms were negligible. During the interaction between molecular oxygen and a platinum ribbon specimen under the experimental conditions employed, oxygen was never observed in the gas desorbed from the platinum ribbon. The experimental procedure used is detailed, and the effects of the various parameters on the sorption/reaction characteristics of oxygen are tabulated. The total mass of gas sorbed as oxygen is generally about an order of magnitude more than the quantity of gas recovered as carbon dioxide during desorption. M.W.R.

N68-21336# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
GEOLOGICAL FACTORS FORMING GRAVITY ANOMALIES AND ISOSTATIC DISTURBANCES [GEOLOGICHESKIYE FACTORY, SOZDAYUSHCHIYE ANOMALII SILY TYAZHESTI I NARUSHAYUSHCHIYE IZOSTAZIYU]
A. A. Borisov Dec. 1967 26 p refs Transl. into ENGLISH from the Publ. "International Geological Congress, Session 22, Reports of Soviet Geologists, Problem 12" Moscow, Nauka Publishing House, 1964 p 57–70
(ACIC-TC-1275; AD-665198)

The paper discusses the importance of the unequal density of the substratum and the changes in the density of the earths crust in relation to the effect on the anomaly field. During a further development of deformation, an important directed change takes place in the composition and thickness of the earths crust. These factors begin to predominate in the gravity anomalies, while the direct influence of the proper subcrustal factors on the anomalies diminishes. Author (TAB)

N68-21337# Osservatorio Geofisico Sperimentale, Trieste (Italy).
REDUCTION OF 1963 OBSERVATIONS. PROGRESS REPORT ON PENDULUM MEASUREMENT Administrative Report, 1 Nov.–31 Jan. 1964
C. Morelli 1968 49 p refs Presented at the Milano Meeting of the S.G.6 and S.G.5, 29–30 Apr. 1964
(Contract AF 61(052)-656)
(Rept.-5; AD-665423)

Contents: Some preliminary comparisons on the 1963 pendulum measurements along the E.A.C.L. with Gulf and Cambridge apparatus; Report for special study group no. 5 of the International Association of Geodesy on gravity measurements in the first order world gravity net with Cambridge pendulum apparatus, carried out by the Finnish Geodetic Institute; Continuation of the Europe-Africa calibration line southward from Rome to Cape Town; Report on Gulf pendulum measurements European-African calibration line. TAB

N68-21336# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

GRAVITATIONAL FIELD OF THE ATLANTIC OCEAN AND ITS CONNECTION WITH THE ABYSSAL STRUCTURE OF THE EARTH'S CRUST [GRAVITATSIONNOYE POLE ATLANTICHESKOGO I YEGO SVYAZ'S GLUBINNYM STROYENIYEM ZEMNOY KORY]

Ye. D. Koryakin Dec. 1967 24 p refs Transl. into ENGLISH from the publ. "Morskiye Gravitatsionnye Issledovaniya" Moscow, Univ. Publishing House, Issue No. 2, 1963 p 35–50
(ACIC-TC-1273; AD-665197)

The paper is a study of the gravitational field of the Atlantic Ocean and its connection with the abyssal structure of the earths crust. There are three main groups of regions: the regions of deep oceanic depressions, the regions of underwater ridges, and oceanic islands and the transition region from the ocean to the continents. The anomalies peculiar to each region are discussed. The comparison of gravimetric, magnetic and seismic data is fully discussed. An observation of the thicknesses of the sedimentary, granitic and basaltic layers in the area of the Atlantic Ocean is made. On the basis of seismic and gravimetric investigations, it is possible to compile a diagram of the plutonic structure in the area of the Atlantic Ocean. The compilation of this diagram is discussed and shown. The author of this article has calculated and constructed a series of profiles which cross the Atlantic Ocean, some of which are presented in this paper. Author (TAB)

N68-21346# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Institut.

INVESTIGATIONS OF SHORTWAVE AND LONGWAVE RADIATION EMITTED INTO SPACE BY THE EARTH AND ITS ATMOSPHERE [UNTERSUCHUNGEN DER VON DER ERDE UND ATMOSPHAERE IN DEN WELTRAUM AUSGESANDTEN KURZWELLIGEN UND LANGWELLIGEN STRAHLUNG]

E. Raschke and I. Tannhaeuser Bundesministerium fuer Wiss. Forsch. Dec. 1967 64 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-39) CFSTI: HC$3.00/MF$0.65

By comparison of the mean cloudiness from satellite photographs with surface observations it is found, that the latter give values which are too high up to 20%. The radiation from the 15 micron CO_2 band is disturbed by high clouds, especially in the tropics, so that the temperature determination becomes erroneous. A method for correction is given. Different methods for the calculation of the outgoing infrared radiation are compared. The differences can be very high. The reasons are investigated. Laboratory absorption measurements may be erroneous caused by adsorption at the walls of the cell. The influence on calculations of radiation fluxes respectively for the interpretation of radiation measurements is high. Author

N68-21351# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

QUANTITATIVE ANALYSIS OF GRAVIMETRIC INVESTIGATIONS OF THE KOPET–DAG FOREDEEP [O KOLICHESTVENNOY INTERPRETATSII GRAVIMETRICHESKIKH ISSLEDOVANIY PREDKOPETDAGSKOGO KRAYEVOGO PROGIBA]

M. Kurbanov and A. Potapova Dec. 1967 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Turkmensk. SSR. Ser. Fiz.-Tekhn. Khim. i Geol. Nauk, no. 6, 1966 p 59–64
(ACIC-TC-1313; AD-665202)

The study of the geological structure of the Kopet-Dag foredeep is a complicated problem. The clarification by geological methods is hampered by the thick sedimentary cover. On the basis of available geophysical data, the interpretation of gravity anomalies is discussed in this paper. Author (TAB)

N68-21354# Academy of Sciences (USSR), Moscow.

PROPAGATION OF LOW FREQUENCY ELECTROMAGNETIC WAVES IN THE EARTH IONOSPHERE WAVEGUIDE

Ya. L. Al'pert, E. G. Guseva, and D. S. Fligel 1967 129 p refs
(AD-665698) CFSTI: HC$3.00/MF$0.65

The report gives a concise review of the present state of research on the propagation of very low frequency (VLF) and extremely low frequency (ELF) waves in the surface waveguide. Calculated values of refraction and damping coefficients, taking neutral particles into account, are given for both the lower ionosphere (D region), and the outer ionosphere, to heights of 3000 to 6000 km. Various theoretical formulas for the field in a waveguide, derived both rigorously and by asymptotic methods, are subjected to analysis, and the theoretical results are compared with most of the experimental data to be found in the literature. Almost all of the worlds available information is used (255 names). The book has 54 illustrations and 13 tables. TAB

N68-21358# Naval Civil Engineering Lab., Port Hueneme, Calif.

COMPUTER REDUCTION OF DATA FROM ENGINEERING TESTS ON SOILS AND OCEAN SEDIMENTS Final Report, Sep. 1964–Mar. 1967

Melvin C. Hironaka Feb. 1968 141 p refs
(R-566; AD-666311)

Because of the tremendous quantity of data generated from tests of ocean floor soils, NCEL has utilized the IBM 1620-11 computer to aid in data reduction. Thirteen programs were written in FORTRAN to reduce the data and to aid in the analysis of the test results. The use of these programs and associated computer techniques affords the benefits of convenience, economy, accuracy, and speed in data reduction. This procedure has also reduced the efforts required in preparing the results in a form suitable for publication. In addition, further analysis of the test results is facilitated by the fact that the results are already catalogued on cards. Author (TAB)

N68-21420# Oregon State Univ., Corvallis. Dept. of Oceanography.

SURFACE TEMPERATURE AND SALINITY OBSERVATIONS AT PACIFIC NORTHWEST SHORE STATIONS FOR 1967

William Gilbert and Bruce Wyatt Feb. 1968 24 p refs
(Contract Nonr-1286(10))
(DR-28; AD-666312)

During 1967 the Department of Oceanography, Oregon State University, continued its program of shore sampling of ocean temperatures and salinities along the coast of the Pacific Northwest. Observations for 1960 through 1966 are contained in five Data Reports which are listed under references. The data in the report were collected at six stations. Author (TAB)

N68-21465# Adelaide Univ. (Australia). Dept. of Physics.

ON THE ANALYSIS OF MOVING PATTERNS IN GEOPHYSICS. 1: CORRELATION ANALYSIS

B. H. Briggs Mar. 1968 30 p refs
(ADP-45) CFSTI: HC$3.00/MF$0.65

The analysis of a moving random pattern is considered for the case where the whole pattern can be recorded. The pattern is assumed to have a certain mean velocity, and also to change randomly in form as it moves. It is shown how the velocity of movement, as well as parameters describing the spatial properties and the random changes, can be derived from two observations of the pattern separated by a known time interval. The results should have applications to radio experiments using large aerial arrays for observations of ionospheric drifts, to photographic observations of moving patterns of light emission from the night sky, and to other similar phenomena. Author

N68-21475# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

RADIATIVE REGIME OVER ARCTIC TUNDRA

Bruce J. Lieske and Leander A. Stroschein Jan. 1968 32 p refs
(Contract Nonr-477(24))
(SR-11; AD-665968)

Incoming short wave, total incoming, and net total radiation were measured continuously near Point Barrow, Alaska (71 degrees N), in 1964 using Kipp and Zonen solarimeters and C.S.I.R.O. radiometers. The incoming short wave radiation reached a maximum monthly energy sum in May. The sum for the year was 343 kJ cm-2. Monthly energy sums of incoming long wave radiation exceeded those of incoming short wave radiation in every month except April and May. The maximum occurred in August, and the sum for the year was 737 kJ cm-2. The net total radiation reached a minimum of -7.7 kJ cm-2 in March and a maximum of 43.2 kJ cm-2 in June; the annual balance was 63.8 kJ cm-2. The radiative regime changed markedly with the melting of the snow in late May, and with the onset of appreciable snow cover in late September. Measurements of tundra albedo during the summer indicated values of 4-34% for various surfaces. The albedo of the grassy surface under the net total radiometer averaged 24%. Empirical relationships were derived for net long wave radiation as a function of cloudiness, and with clear skies as a function of screen temperature. The relationships are similar to those found by Liljequist at Maudheim, Antarctica (71 degrees S). Author (TAB)

N68-21497# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.
BATHYMETRIC REPORT OF SURVEY OPERATIONS IN THE SOUTHEAST PACIFIC OCEAN. USNS JOSIAH WILLARD GIBBS (T-AGRO 1) OPERATION 245, 17 FEBRUARY–16 MARCH 1967
N. Z. Cherkis Oct. 1967 48 p refs
(Contract Nonr-266(84))
(CU-169-67-ONR-266-Phys.; TR-143; AD-666547)

The document reports the bathymetric observations and track charts taken on the cruise of the USNS Josiah Willard Gibbs (T-AGOR 1), during Operation 245 in the Southeast Pacific Ocean. The track of the cruise from Area A to Area D (via Callao) is shown on 12 charts which have been prepared as overlays to U. S. Naval Oceanographic Office BC areas 0803S, 0901N, 0902S, 0903S, 0904S, and 1001N. Also included are charts containing the tracks and contours of surveys conducted on this cruise. Author (TAB)

N68-21512# Ohio State Univ. Research Foundation, Columbus.
KINEMATICAL GEODESY Scientific Interim Report
Helmut Moritz Nov. 1967 100 p refs
(Contract AF 19(628)-5701)
(AFCRL-67-0626; SR-16; Rept.-92; AD-666052)

With the use of moving instruments, such as airborne gravimeters, which are often related to precise inertial stabilization systems, the essentially statical character of geodesy begins to be enlarged by kinematical features. The potential of gravity, combining gravitational attraction and centrifugal force, is no longer adequate for kinematics, but other inertial forces of Coriolis type must also be considered. The main purpose of the present paper is an investigation of the geodetic aspects of the interrelation of gravitational and inertial forces and their separation by means of structural differences in their respective fields. For a deeper insight, the general theory of relativity is indispensable; it also furnishes convenient mathematical techniques. The extraction of purely gravitational effects is possible with second and third derivatives of the potential; therefore geodetic applications of these quantities are discussed, integral formulas similar to Stokes integral being given for this purpose. Author (TAB)

N68-21540# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
INTERACTING MOTION OF RECTILINEAR GEOSTROPHIC VORTICES. 1. LINEAR STABILITY ANALYSIS
George K. Morikawa and Eva V. Swenson Jan. 1968 42 p refs
(Contracts Nonr-285(55); AT(30-1)-1480)
(IMM-364; AD-666124)

The kinematic motion of (N + 1) geostrophic (Bessel) vortices is studied. Initially the vortices are positioned near a uniformly rotating equilibrium configuration which consists of N vortices of equal strength gamma, equally spaced on a circle of radius a, and one vortex of strength gamma sub o at the center of the circle. One length scale 1/kappa is associated with each of the vortices, the limiting case kappa = 0 being the classical logarithmic vortex. The exponential stability of this equilibrium configuration is studied over the range of the three parameters: N > or = 2, 0 < or = (kappa a) < infinity and -infinity < (gamma sub o/gamma) < infinity. The need for a supplementary nonlinear study is discussed. Author (TAB)

N68-21543*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GEOMAGNETIC SECULAR VARIATION 1900–1965
Joseph C. Cain and Shirley J. Hendricks Washington Apr. 1968 224 p refs Presented at the Intern. Union of Geodesy and Geophys. 14th Gen. Assembly, St. Gall, Switzerland, 30 Sep. 1967
(NASA-TN-D-4527) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The GSFC (12/66) model of the main geomagnetic field uses linear and parabolic terms in time, to represent secular change over the interval 1900–1965. The predicted field is compared with observatory annual means to investigate systematic residuals. Deviations of the order of 100_γ occur for short spans of years and only in limited regions. Otherwise, the trends of the computed field parallel the observations. Secular-change charts agree well with those drawn by earlier analyses. The westward drift is generally apparent in the vector representation of the harmonic coefficients, except that a few terms predominantly undergo an amplitude change. The components below (g_8^6, h_8^6) that show a recognizable estward drift are the (3,2), (5,1), and (5,2) terms. Both dipole poles move smoothly northwestward over the interval, whereas the dipole position initially drifts eastward, reverses direction near 1920, and then moves westward at a rate up to about 0.07 degrees per year. Its 1965 position is found to be 78.8°N, 7.0°W. Author

N68-21550# Texas Instruments, Inc., Dallas. Science Services Div.
UNITED STATES NAVAL OCEANOGRAPHIC OFFICE, MARINE GEOPHYSICAL SURVEY PROGRAM 1965–1967, NORTH ATLANTIC OCEAN, NORWEGIAN SEA, AND MEDITERRANEAN SEA, AREA 2. VOLUME 7: DATA CATALOG Final Report
25 Jan. 1968 112 p refs
(Contract N62306-1687)
(SP-95-2-7; AD-666570)

The report describes the data-storage cataloging system for all field data, data-analysis bulk data, and laboratory results acquired in performing contracted tasks for Marine Geophysical Survey, Area 2. All support forms and logs executed aboard ship during survey operations are described in detail. Pertinent data derived from each log or form are encoded in a data-referencing system which is key-punched in IBM format for future computer usage. Any raw data type can be found by consulting a listing of the key-punched data. Similarly, any intermediate data-analysis results can be found. Final data-analysis results are found in other volumes of the SP 95 series. Author (TAB)

N68-21560# Pisa Univ. (Italy). Istituto di Geodesia e Topografia.
ON AN ELECTRONIC CALCULATION PROCESS FOR OBTAINING THE PARAMETERS TO BE USED IN THE APPRAISAL OF THE DEVIATION FROM THE VERTICAL [SU UN PROCEDIMENTO DI CALCOLO ELETTRONICO PER OTTENERE I PARAMETRI DA UTILIZZARE NELLA VALUTAZIONE DELLA DEFLESSIONE DELLA VERTICALE]

Brunetto Palla 1967 9 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 60
(Rept.-1154) CFSTI: HC $3.00/MF $0.65

Gravitation is computed and compared to the actual observed values by a system of zoning of compartmented geographic areas of the earth. These data in conjunction with data obtained from maps are used in determining deviations from the vertical. The criteria for using the components of deviation from the N–S plane and the E–W plane for a FORTRAN 4 program are described. Transl. by F.S.

N68-21566# Texas Instruments, Inc., Dallas. Science Services Div.
UNITED STATES NAVAL OCEANOGRAPHIC OFFICE, MARINE GEOPHYSICAL SURVEY PROGRAM 1965–1967 NORTH ATLANTIC OCEAN, NORWEGIAN SEA AND MEDITERRANEAN SEA, AREA 2. VOLUME 8: FIELD OPERATIONS Final Report, 1 Jun.–15 Oct. 1967
25 Jan. 1968 100 p
(Contract N62306-1687)
(SP-95-2-8; AD-666571)

The volume describes the survey platforms, data-collection systems, staff, and procedures. It goes into detail on data accuracy and calibration procedures and includes a description of the conduct of the survey. Area 2 was the fourth of seven areas surveyed by Texas Instruments under the present contract. The area was surveyed between 1 June and 15 October 1967. Author (TAB)

N68-21594*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GRAVITY MODEL COMPARISON USING GEOS-I LONG ARC ORBITAL SOLUTIONS
Francis J. Lerch, James G. Marsh, and Brian O'Neill (Wolf Res. and Develop. Corp.) Dec. 1967 82 p refs
(NASA-TM-X-63158; X-552-68-71) CFSTI: HC $3.00/MF $0.65 CSCL 08N

Using three different sets of coefficients in the mathematical model that describes the earth's gravitational field, satellite tracking data were analyzed. The three different sets of harmonic coefficients and associated earth parameters are tabulated. In order to choose the most suitable available set of gravity coefficients and station coordinates for long arc geodetic purposes, an assessment is made of the effects that different sets of coefficients, station coordinates, and earth parameters have on orbital geodetic results. Several long arc orbital analyses were completed using each set of coefficients and the results were compared. The arc lengths of these orbits were 5-1/4 days and 1 day. The differences between the observed measurements and values obtained from the orbital solutions were computed and the histograms are shown. B.S.D.

N68-21616*# Hawaii Inst. of Geophysics, Honolulu.
DETERMINATION OF SHAPE OF THE EARTH'S SURFACE AND MASS
Christopher Gregory and Joyce Tanaka Kurio [1967] 41 p
(Grants NGR-12-001-045; NGR-12-001-036)
(NASA-CR-94139) CFSTI: $3.00 CSCL 08E

A suggestion is made for the determination of the earth gravitational potential up to the quadrupole approximation in a local determination via satellite observations. The method introduced enables one to establish also the distance of the center of the earth to the position of the satellite observation station. This would imply that observations from several stations could be used to fix the earth center and consequently to make observations on the shape of the earth. A flow diagram for computations is also presented. Author

N68-21641*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
ALTITUDE DISTRIBUTION, ORIGIN AND FLUX OF SODIUM IN THE ATMOSPHERE
S. N. Ghosh and Ved Mitra Mar. 1968 14 p refs
(Contract NASr-54(05))
(NASA-CR-94125; Rept.-05627-15-S) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Taking the maximum density of Na to be 900 atoms/cc at 93 km, the equilibrium altitude distribution is calculated. It is assumed that equilibrium is first reached among the fast reactions, ionization, recombination and oxidation of Na atoms. Sodium atoms and their compounds, which are minor constituents in the atmosphere, then diffuse and a final equilibrium is reached under the joint effect of chemical equilibrium and diffusion. It is shown that the origin of Na atoms is extraterrestrial and that approximately 554 Na atoms are deposited per sq. cm. per sec in the atmosphere. The shape of the altitude distribution curve resembles fairly well with those obtained experimentally. Author

N68-21653# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.
OZONESONDE OBSERVATIONS OVER NORTH AMERICA, VOLUME 4 Interim Report, Sep. 1964–Jan. 1966
Wayne S. Hering and Thomas R. Borden, Jr. Dec. 1967 376 p refs *Its* Environ. Res. Papers, No. 279
(AFCRL-64-30, V. 4; AD-666436)

An experimental program for the measurement of the vertical ozone distribution was established by the Air Force Cambridge Research Laboratories in January 1963. Observations from eleven network stations spread throughout North America are being published in a series of reports. This fourth volume contains ozonagrams for individual ozonesonde ascents made during the period September 1964 to January 1966. The report also presents a statistical summary of the ozonesonde data for the three-year period ending December 1965. Seasonal mean ozone profiles and the standard deviations from the average distributions are given for each station. Correlations of the ozone concentration at specific levels with temperature, pressure, and total ozone are also summarized. Author (TAB)

N68-21657# Texas A&M Univ., College Station. Dept. of Oceanography.
THE EFFECT OF TOPOGRAPHY ON THE YUCATAN CURRENT
Robert L. Molinari Jan. 1968 60 p refs
(Contract Nonr-2119(04))
(Rept.-67-24T; AD-665971)

The effect of topography on a portion of the Yucatan Current, east and northeast of the Yucatan Peninsula, during May of 1962, 1965 and 1966 is investigated. The month of May is chosen because the current is strong and the core of the current is readily discernible. A graphical method is used in solving the conservation of potential vorticity on the basis of actual topography and observed initial velocity. A numerical method based on a simplified topography is also used as a check on the subjectivity of the graphical method. Through this procedure a path of the current core is obtained. The computed path is then compared to the observed path. It is found that in the three cases the calculated paths agree quite well with the observed paths, from the Yucatan Strait north a distance of 2 degrees to approximately 23 degrees 30N. The current paths studied all closely follow a particular isobath with meanders of small amplitude in this region. North of 23 degrees 30N a more complicated topographic region is encountered. The calculated paths develop meanders with large amplitudes which seem to be in disagreement with the few observations in that region. This possible disagreement is discussed. Author (TAB)

N68-21695# Avco-Everett Research Lab., Everett, Mass.
INTERACTION OF THE EARTH'S MAGNETIC FIELD WITH THE SOLAR WIND Final Report, 1 Jul.–31 Dec. 1967
Richard M. Patrick 31 Dec. 1967 61 p refs
(Contract AF 19(628)-6086)
(AFCRL-68-0047; AD-666442)

Plasma wind tunnel has been constructed with the goal of producing a collision free fully ionized stream of hydrogen in which stationary collision free shocks can be produced. Such a flow has been produced with a magnetic field buried in the flow with components both perpendicular and parallel to the flow direction. Stationary shock waves have been created in this flow by placing a magnetic dipole in the flow with its axis parallel to the flow direction. The flow geometry has been studied using magnetic and electric probes, along with photographs of the flow. The structure of shock waves in fully ionized hydrogen flow has been studied, and the thickness of the shock waves is equal to several ion gyro radii when the Alfven Mach number of the flow is between 2 and 3 and the angle of the B field with respect to the flow direction is between 45 and 80 degrees. Furthermore, oscillations in the B and E fields are seen to stand ahead of the main shock jump with frequencies larger than the ion gryo frequency. A crude estimate of the dissipation due to these oscillations upon the ionized flow in the shock indicates that these standing magnetohydrodynamic waves may account for the dissipation required for the shock jump conditions when the Alfven Mach number is between 1.5 and 3. TAB

N68-21699# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
RESEARCH IN SEISMOLOGY Annual Report, 1 Nov. 1966–31 Oct. 1967
Frank Press and M. Nafi Toksoez 31 Oct. 1967 111 p refs
(Contract AF 49(638)-1632; ARPA Order 292-66; Proj. Vela-Uniform)
(S-2; AD-666482)

The seismic research activities are grouped in four categories. In the first, the utilization of LASA data for various seismological studies is discussed. P-wave velocity-depth distribution in the mantle is obtained along two profiles. Frequency-wavenumber structure of microseisms are investigated using both the long and short period data from LASA and it is found that at periods shorter than 5 seconds predominant noise peaks correspond to higher mode Rayleigh waves and p-wave noise. The structure and inhomogeneities of the upper mantle are studied using seismic and other geophysical data. In Japan the surface wave dispersion data are best fitted by a model containing thin soft layers in the upper mantle. Seismic, heat flow, geopotential, surface topography and crustal data are correlated using coefficients of spherical harmonics up to the third order. It is found that some lateral density variations may exist in the upper and lower mantle. The near source and far-field seismic data from the Parkfield earthquake of 1966 are analyzed for source mechanism and attenuation studies. Author (TAB)

N68-21709# Joint Publications Research Service, Washington, D. C.
A NEW METHOD OF STUDYING TEMPERATURE VARIATIONS IN THE SEA
E. M. Litvinov and N. N. Trubyatchinskiy 16 Apr. 1968 4 p refs Transl. into ENGLISH from Rybn. Khozy. (Moscow), no. 8, 1967 p 8–10
(JPRS-45050) CFSTI: HC $3.00/MF $0.65

Observations on the temperature variability of sea water with respect to time were made using buoy stations attached to a drifting ship. A thermokosa was employed to secure continuous, synchronous measurements at several levels. Assessed are results of studies of temperature variations in the Atlantic Ocean near the Azores which were made using the proposed method. It is concluded that the proposed method could be used in studies on the variability of the physical parameters of water and of the indices of its chemical composition, and used with simultaneous determinations of the biomass of nutritive and industrially valuable organisms. S.C.W.

N68-21749# Adelaide Univ. (Australia). Dept. of Physics.
ON THE ANALYSIS OF MOVING PATTERNS IN GEOPHYSICS. 2: DISPERSION ANALYSIS
B. H. Briggs Mar. 1968 16 p refs
(ADP-46) CFSTI: HC $3.00/MF $0.65

A method of dispersion analysis is described which enables the velocity of each spatial Fourier component of a two-dimensional pattern to be calculated from records of the pattern obtained at two times. From the results, it is possible to determine if the velocity is a function of wavelength. This may be a useful method of analysis when dispersive wave motions play a part in the movements of the pattern. It should have applications to the study of ionospheric movements in experiments which use large arrays of aerials. The analysis may also have applications to other phenomena such as moving patterns of light emission from the night sky, observations of the form of the surface of the sea, and other geophysical phenomena in which moving patterns occur. Author

N68-21756*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
ALTITUDE DISTRIBUTIONS OF AND RADIATIONS FROM CERTAIN OXYGEN AND NITROGEN METASTABLE CONSTITUENTS Scientific Report
S. N. Ghosh and S. K. Gupta Mar. 1968 24 p refs
(Contract NASr-54(05); ORA Proj. 05627)
(NASA-CR-94130; Rept.-05627-17-S) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The airglow emitted by certain metastable constituents $N(^2D)$, $O(^1D)$, $O^+(^2P)$, and $O^+(^2D)$ in the daytime atmosphere is investigated and their altitude distributions are obtained. The production of $N(^2D)$ atoms by dissociative recombination of N_2^+ with electrons is considered. Their quenching by collisions with electrons and O_2 molecules is calculated, and it was shown that if quenching by electrons is neglected, the calculated integrated intensity of NI 5199 line agrees with the observed value. Assuming collisional deactivation of $O(^1D)$ atoms by O_2 molecules, the production rates of $O(^1D)$ by photo-dissociation of O_2 in the Schumann–Runge continuum at low, medium and high activities of the sun are calculated. The $O(^1D)$ distribution and rates of emission of the oxygen red line in the dayglow are also calculated. Calculated intensity at minimum activity agrees with the observed value. The production rates of metastable $O^+(^2P)$ and $O^+(^2D)$ ions by photoionization of O atoms are calculated. Their equilibrium distributions are computed after using the recent data of rate coefficients for ion-atom interchange and other ionic reactions. Author

N68-21778*# Yale Univ., New Haven, Conn.
RELATIONSHIP, THROUGH GEOLOGIC TIME, OF DAYS PER LUNAR MONTH TO GROWTH INCREMENTS IN FOSSIL AND RECENT MOLLUSCAN SHELLS Semiannual Status Report, 14 Sep. 1967–14 Mar. 1968
Copeland Mac Clintock and Giorgio Pannella 24 Apr. 1968 7 p
(Grant NGR-07-004-034)
(NASA-CR-94128) CFSTI: HC $3.00/MF $0.65 CSCL 08G

The results of a preliminary survey is presented on the growth patterns in fossil bivalves from the Miocene, Eocene, Cretaceous and Pennsylvanian of North America. For control and comparison, counts of Recent bivalves are also shown. The number of days per lunar month ranged between twenty-six and thirty-five days. The average number of days per lunar month were computed for: the Recent from 104 counts in four specimens, the Miocene from 16 counts in one specimen, the Cretaceous from 55 counts

in three specimens, the Eocene from 88 counts in 2 specimens, and the Pennsylvanian from 119 counts in four specimens. Another promising method mentioned for studying periodicity in fossils, is the analysis of surface topography. B.S.D.

N68-21777*# Hawaii Inst. of Geophysics, Honolulu.
A REVIEW OF THE PERTURBATION THEORY AS APPLIED TO THE DETERMINATION OF GEOPOTENTIAL
Mohammed Asadullah Khan and George P. Woollard Jan. 1968 66 p refs
(Grant NGR-12-001-045)
(NASA-CR-94126; HIG-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A review of close satellite theory as applied to determine geopotential from the orbital motion of artificial earth satellites is given. The most recent dynamical solutions for geopotential coefficients obtained from the optical and Doppler tracking of satellites are used to compute the earth's anomalous gravity field in terms of geoidal undulations and gravity anomalies with respect to the various reference ellipsoids. A 'mean solution,' obtained from a linear combination of three of the available solutions, is also used for the same purpose. The maximum departure of the geoid from the surface of the international reference ellipsoid is much greater than that usually obtained from surface gravity data. As expected, the shorter wavelength component seems to be most poorly represented in the satellite data. Author

N68-21817# Joint Publications Research Service, Washington, D. C.
FIRST USSR EXPERIMENTS WITH SADKO-2 UNDERWATER "APARTMENT"
S. Sergeyev 24 Apr. 1968 7 p Transl. into ENGLISH from Izv. (Moscow), 15 Nov. 1967 p 4
(JPRS-45154) CFSTI: HC $3.00/MF $0.65

Presented is a discussion of the first Soviet experiments in the Black Sea using Sadko-2, an underwater apartment for housing aquanauts. The submarine house was placed at a depth of 25 meters. Two aquanauts lived in the underwater apartment for an extended period of time, their mission being to develop a procedure for investigating hydrophysical processes in the littoral zone. Of significance is the fact that submariners left the house several times to make observations at depths of up to 50 meters which was a record dive for these conditions. Described are experiences of astronauts after prolonged periods in Sadko-2; the medical engineering group responsible for the design of the laboratory; medical observers working with the aquanauts; and experiences of aquanauts during turbulent weather conditions and after prolonged periods of confinement. S.C.W.

N68-21818# Joint Publications Research Service, Washington, D. C.
ELECTRICAL FIELD MEASUREMENTS AT SEA
F. I. Eskin 16 Apr. 1968 5 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 18, 1967 p 169–170
(JPRS-45051) CFSTI: HC $3.00/MF $0.65

Circuit induction problems inherent in the use of contact electrodes for measuring natural electrical fields at sea are discussed. Assessed are results of measurements made aboard the scientific ship Bataysk in the Northern Atlantic. Tested were two pairs of silver–silver chloride electrodes. The electrodes had permanent and internal potential of not more than 0.2 mv. Each was joined to its own potentiometer so that a space circuit would appear in one pair and not in the other. The potentiometers were drawn through the water at a rate of 1,200 mm/hr and thus permitted recording of oscillations with periods of three seconds or greater. The experiment demonstrated that the induction emf for a vertical marine circuit comprises a substantial proportion of the total signal, and therefore cannot be neglected. S.C.W.

N68-21823# Joint Publications Research Service, Washington, D. C.
TURBULENT INHOMOGENEITIES IN THE SEA INVESTIGATED
N. K. Shelkovnikov 19 Apr. 1968 3 p Transl. into ENGLISH from Vestn. Mosk. Univ. Astron. (Moscow), no. 6, 1967 p 118–120
(JPRS-45104) CFSTI: HC $3.00/MF $0.65

Reported are results of studies designed to experimentally determine the spatial geometry and dynamics of temperature inhomogeneities in the sea using an electronic instrument for continuous and simultaneous recording of turbulent temperature fluctuations at four spatially separate points. Analyzed is the proficiency of the proposed instrument during three expeditions on the Black Sea. Preliminary results with respect to statistical investigations of the temperature inhomogeneities in the sea are presented. Assessed are data obtained during measurements onboard ship, and measurements obtained with the instrument on the ocean floor. S.C.W.

N68-21830# Kiruna Geophysical Observatory (Sweden).
PCA EVENTS OBSERVED AT KIRUNA IN THE YEAR 1965 AND 1966: DATA COLLOCATION
[1967] 46 p *Its* Geophys. Data Suppl. No. 67-1
CFSTI: HC $3.00/MF $0.65

Data tables and related computations for polar cap absorption events observed at Kiruna between February 1965 and September 1966 are presented. S.C.W.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-20577 Illionis Univ., Urbana.
A VACUUM GRATING MONOCHROMATOR FOR THE FAR-INFRARED
Roberto Hilarion Rafael Roldan Alvarez (Ph.D. Thesis) 1966 84 p Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-6716

This thesis reports on the construction and testing of a far-infrared grating monochromator capable of operation in the 100–2000 μ spectral region. This instrument uses echelette gratings as main dispersive elements. Filtering of the radiation was obtained by means of reflection filter gratings and polyethylene windows. Either a Golay Cell or a helium cooled carbon bolometer was used as a detector. Metal light pipes and condenser cones were used as convenient means of conveying the radiation from the monochromator to the detector. The entire optical path was placed in a vacuum system in order to eliminate absorption due to water vapor present in the air. Clear spectra, showing a resolution of the order of 2% have been obtained with scan times of the order of one hour over an octave of frequency. The monochromator was calibrated using the absorption lines of HCl, HBr and water vapor. With this calibration, the position of the absorption lines for the other gases was determined to within 2 microns. Dissert. Abstr.

N68-20645# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
THE DIELECTRIC RELAXATION SPECTRA OF WATER, ICE, AND AQUEOUS SOLUTIONS AND THEIR INTERPRETATION. 4: A FREQUENCY-SWEEPING BRIDGE ASSEMBLY WITH AUTOMATIC PLOTTING OF CAPACITANCE AND LOSS FROM 1 TO 200 Hz.

Modesto A. Maidique Dec. 1967 39 p refs
(Contract N00014-67-A-0204-0003)
(TR-4; AD-665671)

A fully automatic, low-frequency dielectric measurement system has been developed that will extend the measurement facilities of the Laboratory for Insulation Research two decades below 100 Hz. The system automatically balances, sweeps from 1 to 200 Hz while retaining balance, computes the value of loss tangent, and plots loss tangent and sample capacitance vs. frequency by means of two external recorders. Accuracy of the output plots is within 1% plus or minus 1 pf for the sample capacitance and 10% plus or minus 0.0001 for the loss tangent. Samples from 100 to 1100 pf, and 0.0002 to 0.35 loss tangent can be measured directly, while accuracy criteria determine minimum or maximum values for substitution measurements. A run from 200 to 1 Hz can be completed in about 45 minutes. Author (TAB)

N68-20646# Naval Radiological Defense Labs., San Francisco, Calif.
PULSE HEIGHT ANALYZERS: COMPUTER-COMPATIBLE OUTPUT FOR BOTH STATIONARY AND MOBILE SYSTEMS
Bruce A. Euler 5 Nov. 1967 34 p refs
(USNRDL-TR-68-4; AD-665608)

As the utilization of digital computer techniques for the analysis of pulse height spectra increases, it is important to develop efficient and reliable techniques for linking the pulse height analyzer to the computer. Two computer-compatible analyzer output media, punched cards and magnetic tape, were found to be practical and appropriate for providing computer coupling for an array of pulse height spectrometers which are used for making high-quality measurements in gamma-ray spectrometry. Both stationary and mobile installations were accommodated. An IBM-523 Gang Summary Punch, in conjunction with a specially built buffer unit, is used to provide fast punched card readout from 256-, 1024-, and 16,384-channel pulse height analyzers. Computer-compatible magnetic tape readout is provided on a 4,096-channel and a 16,384-channel pulse height analyzer. Author (TAB)

N68-20651 Minnesota Univ., Minneapolis.
NOISE IN SPACE-CHARGE-LIMITED CURRENT FLOW IN SOLID STATE DEVICES
Sheng Teng Hsu (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-5205

A new noise spectrum analyzer, using cross-correlation techniques, was built. The machine is able to detect the thermal noise of a resistor of a few ohms. The limiting noise of SCL solid state diodes was found to be thermal noise. For an ideal diode which follows square law, the noise is twice the thermal noise of its differential conductance. The noise of a SCL solid state triode is given. The gate structure factor of the triodes used in this study is found to be equal to 0.73. The gate shows thermal noise of the input conductance in a wide frequency range. The gate noise and the drain noise are practically uncorrelated. Dissert. Abstr.

N68-20749# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
STUDIES ON A D-REGION MOBILITY SPECTROMETER
T. J. Kuo 15 Feb. 1968 61 p refs
(Contracts DAAD05-67-C-0642; DA-ARO-31-124-G659)
(SR-315, AD-665407)

A theory of mobility spectrometer applicable in the 40-70 km altitude range is presented. This theory is an extension of a previous work. The device is entirely based on the continuum concepts, which measures the mobility and abundance of the various constituents. The resolution of this device in mobility is within 1.4%. Author (TAB)

N68-20750# Oklahoma State Univ. Research Foundation, Stillwater.
INVESTIGATION OF HIGH TEMPERATURE RELAXATION TIMES Final Report
Thomas G. Winter Dec. 1967 4 p
(Grant DA-ARO(D)-31-124-G723)
(AD-664793) CFSTI: HC $3.00/MF $0.65

A brief summary is given of work involving the design, construction and operation of two instruments for the measurement of molecular relaxation times in high temperature gases. TAB

N68-20925# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
AIRCRAFT POLARIMETRIC AND PHOTOMETRIC OBSERVATIONS
W. G. Egan Mar. 1968 24 p refs Presented at the 5th Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 16–18 Apr. 1968
(RM-410J)

A portable electronic, large scale nonimaging polarimeter/photometer has been used in a light aircraft for observations of a pure red pine (Pinus resinosa) stand, the Atlantic Ocean, snow, and sea ice. The optical sensing head, with an angular acceptance angle of 1 degree, has been designed to permit adaptation for laboratory and surface vehicle measurements in the spectral region from 0.3 to 3 microns. The wavelength bands are selected by the use of broadband or interference filters. Initial aircraft observations were made at wavelengths of 0.533 and 1.0 microns, between altitudes of 1000 and 9000 feet under cloudless conditions with the nonimaging sensor. Simultaneously, a photographic record was made of the sensed area with a 16 mm camera. Laboratory observations have been made of red pine leaves with the sensor to aid in the interpretation of field observations. A red pine area was located, using polarization, without any prior knowledge of its existence. It is concluded that it is possible to use polarization with photometry to define clearly the red pine stand; and also to measure the sea state (wave height and direction). The diversity and quantity of polarimetric and photometric observations that can be obtained, indicate the utility of this type of measurement for terrestrial, airborne, and satellite remote sensing. Author

N68-21015# Panametrics, Inc., Waltham, Mass.
A ROCKET BORNE AIR DENSITY MEASUREMENT SYSTEM UTILIZING ELECTRON-BREMSSTRAHLUNG CALIBRATION AND FLIGHT
Bach Sellers, Richard Smith, and Frederick A. Hanser Nov. 1967 69 p refs
(Contract AF 19(628)-5943)
(SR-1; AFCRL-67-0613; AD-665887)

Calibration and Flight of rocket systems for density measurement in the 100 - 200 km region is described. This system utilizes detection of bremsstrahlung x-rays generated by injection of an electron beam from the rocket into the atmosphere. At the high altitudes for which this system is designed the detected x-ray flux is linearly related to the ambient air density. Data on calibration of two payloads is given, and an analysis is made of results obtained when one of these was flown. Due to the fact that the electron beam current ceased almost immediately after the guns were opened, no air density information was obtained. A useful altitude profile of x-ray background was measured. Conclusions are given with regard to probable causes for lack of beam current, and with regard to the calibrations obtained. Recommendations related to further flights are presented. Author (TAB)

N68-21032# North Carolina Univ., Chapel Hill.
PHYSICS OF THE PHOTOGRAPHIC PROCESS
Lawrence Slifkin Sep. 1967 24 p refs
(Contract AT(40-1)-2036)
(ORO-2036-3) CFSTI: HC $3.00/MF $0.65

A summary of the current understanding of the physical phenomena of the photographic process is presented. Topics discussed include electron band structure of silver bromide and chloride, formation of the latent image, electrons and holes, reciprocity failure and the latent image, latent image regression effects, sensitization, and high energy radiation and particles. NSA

N68-21075# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM, PART 2 Quarterly Technical Report, Jul.–Sep. 1967
M. N. Baldwin, R. H. Clark, and J. E. Rogers Dec. 1967 44 p refs
(Contract AT(30-1)-3647)
(BAW-3647-6) CFSTI: HC$3.00/MF$0.65

A description of the critical assembly, used for in-core checking of an all-solid, self-powered in-core neutron detector for power reactors, is described. A brief description of the detector is given. Axial traverse measurements of integrated charge, which is proportional to flux, are described; values are listed. Fission density measurements are presented as a function of detector signal. Normalized power distribution measurements are tabulated. Use of rhodium wires for calibration of the detector is detailed. NSA

N68-21083# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
LIQUID METAL LEVEL MEASUREMENT (SODIUM) STATE OF THE ART STUDY
H. W. Slocomb 15 Nov. 1967 34 p refs
(Contract AT(04-3)-700)
(NAA-SR-MEMO-12582) CFSTI: HC$3.00/MF$0.65

Level measuring devices for liquid metal systems and characteristics of the measuring techniques are outlined. Discussed are the point contact, the resistance tube, and various forms of inductive sensors. Other techniques described include pressure transducers, surface float, displacement float, ultrasonic, pulse delay line, and microwave cavity. NSA

N68-21084# Georgia Inst. of Tech., Atlanta.
SPARK COUNTER NEUTRON DETECTOR FOR HIGH-TEMPERATURE APPLICATIONS Annual Summary Report, 1 Sep. 1966–29 Jul. 1967
Geoffrey G. Eichholz Jul. 1967 33 p refs
(Contract AT(40-1)-3563)
(TID-24212) CFSTI: HC$3.00/MF$0.65

Spark counters of the corrugated electrode type have been designed and tested for use as neutron detectors in high neutron fluxes and at high temperatures. Work done in the first stages of this project has been concerned with the separate study of neutron detection operating characteristics for different counter configurations and electrode spacings and with the investigation of the effect of temperature on counter operations. Using four boron nitride converter disks in a 2-inch detector, efficiencies of the order of 10^{-7} counts/neutron were obtained. Operating the counters at temperatures up to 400°F, downward shifts in operating voltage were observed but no appreciable loss in sensitivity, in neutron fluxes of the order of 10^{6}–10^{7} neutrons/cm^{2}sec. Higher flux measurements were deferred until the effect of neutron heating in the boron nitride disks could be determined. It was found that a boron nitride disk mounted between two aluminum washers incurred a temperature rise of only 14°F above the ambient graphite plug temperature in a flux of 10^{13} n/cm^{2}sec. Higher flux exposures of the neutron detector itself are consequently in progress. Author (NSA)

N68-21089# IIT Research Inst., Chicago, Ill.
AN ELECTRON BEAM SCANNING SYSTEM FOR MEASURING DIELECTRIC PROPERTIES Final Report, 22 Aug. 1966–21 Apr. 1967
Henry Seiwatz Nov. 1967 15 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2825) CFSTI: HC$3.00/MF$0.65

An electron beam scanning system for measuring conduction, capacitance, and field reversal voltage for ferroelectric ceramics is described. The results of preliminary measurements on materials with high dielectric constants are discussed. NSA

N68-21118# Oak Ridge National Lab., Tenn.
THE OAK RIDGE COMPUTER-CONTROLLED X-RAY DIFFRACTOMETER
W. R. Busing, R. D. Ellison, H. A. Levy, S. P. King, and R. T. Roseberry Jan. 1968 259 p
(Contract W-7405-ENG-26)
(ORNL-4143) CFSTI: HC$3.00/MF$0.65

The Oak Ridge computer-controlled x-ray diffractometer consists of a Picker four-circle diffractometer interfaced to a Digital Equipment Corporation PDP-5 computer. A system of programs has been developed which facilitates the collection of three-dimensional single-crystal intensity data. This report includes detailed instructions for using the instrument, a description of the interface hardware and software, and a complete listing of the computer programs. Author (NSA)

N68-21151# Argonne National Lab., Ill.
A HIGH-TEMPERATURE, CONTROLLED-ATMOSPHERE X-RAY DIFFRACTOMETER ATTACHMENT
J. H. Maurer and R. J. Ackermann Sep. 1967 18 p refs
(Contract W-31-109-ENG-38)
(ANL-7257) CFSTI: HC$3.00/MF$0.65

The design of an attachment to be used with a Norelco Wide Range Goniometer at controlled atmospheres at temperatures up to 2500°C is presented. The attachment is designed to maintain precise specimen alignment over broad temperature ranges and simultaneous precise control of known temperatures and compositions of the specimens. NSA

N68-21152# Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany).
DEVELOPMENT OF A SEMIACTIVE TEMPERATURE CONTROL SYSTEM [ENTWICKLUNGSARBEITEN AN EINEM HALBAKTIVEN TEMPERATUR-REGELSYSTEM]
R. Bey, E. Hermann, and B. Kalkbrenner Oct. 1967 60 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-32) CFSTI: HC$3.00/MF$0.65

Semiactive temperature control systems give a simple and reliable way to minimize temperature variations within satellites by varying the radiation properties of the surface, obtained by the thermostatically regulated opening or closing of movable cover blades with low absorptivity placed above areas with high emissivity. This paper describes the development of such a system which—in opposition to past developments—guarantees by application of two temperature sensors, that the shutters will open when the internal temperatures exceed the preset upper limit, but only then, when the outer sensor reads a colder temperature. Author

N68-21160# Aerospace Medical Div., Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
COMPARISON OF BEHIND-THE-LENS METER READINGS AND INCIDENT LIGHT METER READINGS IN PRODUCING 35MM COLOR SLIDES FOR TECHNICAL TRAINING CLASSES Final Report, Sep. 1965–Feb. 1966
Edgar A. Smith Sep. 1967 24 p
(AMRL-TR-66-112; AD-665467)

The study reported here relates to the possibility that behind-the-lens meters in 35mm cameras might facilitate the taking of colored slides by simplifying the technique for determining exposure. A series of test slides, representing various types of slides used in technical training classes, briefings, and presentations was

made and evaluated. These pictures included indoor shots of charts, graphs, newspaper clippings, colored posters, and live subjects. The data indicate that exposure estimates obtained from behind-the-lens meters vary significantly from those obtained from incident light meters. In approximately one-half of the 48 cases compared, the difference was at least one f-stop. The difference was not systematic but varied in both degree and direction. When viewing the slides in pairs, both a group of 37 university students and a group of 17 adult members of a photography club exhibited a strong tendency to find the slide based on the incident light meter to be more acceptable than the slide based on the behind-the-lens meter. Author (TAB)

N68-21168# Arizona Univ., Tucson.
A TWO CHANNEL PHOTOGRAPHIC PLATE GUIDING CONTROL SYSTEM
Michael A. Reed 10 Oct. 1967 63 p refs
(TR-20; PB-176710) CFSTI: HC $3.00/MF $0.65

The control system described in this thesis was designed to automatically guide the position of photographic plates during long exposures of astronomical objects. The system senses the position of the guide star which is being used as a position reference, and moves the photographic plate in two orthogonal directions in order to maintain a constant position of the image of the astronomical object on the photographic plate. The system was designed to have a bandwidth of 35 radians per second in order to track the worst case image excursions due to atmospheric turbulence and telescope motion. The closed loop transient response of the system was determined from considerations of final image resolution of the photographic plate. Due to the necessity of guiding on stars of unknown brightness the system incorporated an automatic gain control loop within the forward control loop and was made unconditionally stable by high order feedback. In operation on the Steward Observatory telescopes, the system has made a significant increase in photographic plate resolution over manually guided plates. Author

N68-21169*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE OPERATION OF AN ELECTRON PARAMAGNETIC RESONANCE SPECTROMETER
F. E. Geiger, Jr. Washington Apr. 1968 13 p refs
(NASA-TN-D-4469) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Discussed is the operation of an electron paramagnetic resonance microwave spectrometer and expressions are given for the signal obtained from a paramagnetic sample with RF susceptibility $\chi = \chi' - j\chi''$. Calculations are made to the second order of χ'' and χ'. Also studied are the effect of relative microwave power in the signal arm and in the bias or reference arm of the microwave bridge, and the effects of crystal detector characteristics on the optimum cavity reflection coefficient. Expressions for signals are developed for balanced-bridge operation with small phase or amplitude unbalance and for bridge operation with biasing arrangements for the detecting crystal. Author

N68-21176# Commissariat a l'Energie Atomique, Pierrelatte (France).
POSITION CONTROL MECHANISM FOR ION BEAMS IN A MASS SPECTROMETER [DISPOSITIF D ASSERVISSEMENT EN POSITION DES FAISCEAUX D'IONS DANS UN SPECTROMETRE DE MASSE]
Robert Boyer Sep. 1967 42 p In FRENCH
(CEA-R-3268)

An original procedure is described which allows very accurate control of the ion beam position in mass spectrometers used for isotopic analysis with dual collection. The stability value obtained is a value for the stability of the accelerating voltage or the analyzing magnetic field of the order of 10^{-6} (relative value). This procedure has the advantage of multiplying by ten the useful reading time for isotopic yields and in principle thus increasing the precision of enrichment measurements. Author (NSA)

N68-21217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERACTION EFFECTS IN MEASUREMENT SYSTEMS
D. R. Englund Washington 1968 27 p Presented at the 15th Ann. Cleveland Electron. Conf., 16–18 Apr. 1968
(NASA-TM-X-52428) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Presented is a discussion of the problem of matching an instrument to a system such that a minimum disturbance is generated when the instrument is connected. The concept of loading, as determined by such properties as impedance or stiffness, is used to describe these interaction effects. Practical examples of measurements of electrical quantities, temperature, force, pressure, and flowrate are used as a basis for the discussion. Author

N68-21235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY. 15: ROCKET MEASUREMENTS AND INSTRUMENTATION
Clarence C. Gettelman Washington 1968 13 p refs Presented at Lewis Aerospace Explorers Conf., Cleveland, 1966–1967
(NASA-TM-X-52402) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Equations defining typical characteristics of rocket performance are resolved into factors which are readily measurable, and the instruments for measuring these factors of thrust, time, volume flow rate, pressure, temperature, and diameter are discussed. The strain gage is discussed in relation to its design and function, and the springs used in both thrust and pressure transducers are assessed. The thermocouple and resistance thermometer, two devices extensively used to measure temperature, are examined along with vane and turbine meters which are used to measure volume flow rate. B.S.D.

N68-21244# Data Corp., Dayton, Ohio.
THIN FILM GAUGING MACHINE FEASIBILITY STUDY Final Report
Paul L. Faust May 1967 46 p Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2509) CFSTI: HC $3.00/MF $0.65

The results of a feasibility study for a high-precision, noncontacting optical profilometer which is intended primarily to measure precision thin-film circuit elements are presented. It was desired that the system resolve vertical measurements within 0.8 microinch and lateral positions within 40 microinches. The fiduciary was a light spot 40 microinches in diameter. The merits of manual, semiautomatic and automatic systems are outlined. Resolving and servo schemes are discussed. Author (NSA)

N68-21255# Chalmers Univ. of Technology, Gothenburg (Sweden).
A CRYOSTAT FOR GALVANOMAGNETIC MEASUREMENTS ON SEMICONDUCTORS AT LOW TEMPERATURES
Goesta Swenson 1967 30 p refs
(Rept.-313) CFSTI: HC $3.00/MF $0.65

A cryostat for measuring resistivity, Hall-effect and magnetoresistance on semiconductors in the temperature range 2–300°K is described. The apparatus enables measurements to be made on samples of resistance up to 10^{11} Ω. The vibrating reed electrometer used in connection with the cryostat permits a Hall mobility of 10 $cm^2 V^{-1}s^{-1}$ to be detected when the applied electric and magnetic fields are of the order of 1 V/cm and 1000 gauss respectively. The qualities of the apparatus are illustrated by results obtained for antimony and indium doped germanium samples. Author

N68-21348# Comitato Nazionale per l'Energie Nucleare, Rome (Italy).
SYSTEM FOR THE AUTOMATIC ANALYSIS OF FILM OF SCINTILLATION CHAMBER [SISTEMA PER L'ANALISI AUTOMATICA DI FILM DI CAMERE A SCINTILLA]

F. Pandarese and M. Spinetti 1967 28 p refs In ITALIAN
(RT/EL(67)13) CFSTI: HC $3.00/MF $0.65

An automatic system of analyzing scintillation photographs is described, which consists of establishing a coordinate for a significant point determined by the nature and frequency of the fission, and the random location of the scintillation. Binary digits are used to identify the photographs. The system is based on a method of scanning a luminous point which can be used to calculate magnetic deflections from a cathode ray tube. Examples are given to show how these film data can be stored in the computer memory. Transl. by F.S.

N68-21359# American Science and Engineering, Inc., Cambridge, Mass.
FLOW AND ELECTRIC FIELD EFFECTS ON THE RESPONSE OF A STAGNATION POINT MASS SPECTROMETER Final Scientific Report, 15 May 1966–14 Oct. 1967
Shimshon Frankenthal 27 Oct. 1967 64 p refs
(Contract AF 19(628)-6005)
(ASE-1761; AFCRL-67-0607; AD-666450)

The interaction of charged particles with the electrostatic and flow fields surrounding a rocket-borne mass spectrometer is considered. The objective is to relate the ambient density of various ionic constituents of the ionosphere to the corresponding currents reaching the spectrometer orifice. The interaction is analyzed at low altitudes where space charge effects can be neglected and at intermediate altitudes where these effects are dominant. At high altitudes, older results corresponding to free molecular flow are applicable. The performance of the device in measurements of negative ions is considered from the point of view of the double probe theory. Author (TAB)

N68-21384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A VENTURI METER WITH SEPARABLE DIFFUSER
Thomas J. Dudzinski, Robert C. Johnson, and Lloyd N. Krause Washington Apr. 1968 18 p refs
(NASA-TM-X-1570) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The effects on venturi meter efficiency and discharge coefficient of a radial, outward step at the transition from throat to diffuser are reported over a Reynolds number range of 1×10^4 to 5×10^5 and over a Mach number range of 0.2 to 1.0. Step size was varied from 0 to 12.5 percent of the throat radius. Diffuser efficiency was dependent on Reynolds number, Mach number, and step size greater than 2 percent. The discharge coefficient was independent of Mach number, step size, and back-pressure variation for critical flow. Author

N68-21438# General Electric Co., New York. Research and Development Center.
AN INTRODUCTION TO MULTICOLOR HOLOGRAPHY
V. V. Horvath Sep. 1967 8 p refs
(Rept.-67-C-356)

Recent advances in holography are described which have led to the development of holograms which can be reconstructed to form images in three-dimensions and in color. The properties of the photographic emulsion used in recording holograms are discussed for different conditions of coherent illumination. These topics are treated in a qualitative manner to provide an introduction to the subject of multicolor holography from primarily a physical (non-rigorous) point of view. Author

N68-21440*# TRW Systems Group, Redondo Beach, Calif.
FLIGHT PROTOTYPE MODEL METEOR FLASH ANALYZER Final Report
F. N. Mastrup and C. D. Bass Apr. 1968 194 p refs
(Contract NAS9-6532)
(NASA-CR-92047; TRW-05202-6015-R000) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The concept for carrying out an experiment for detecting and analyzing optical meteor flashes generated from planetary meteor entry has been studied and feasibility has been demonstrated. A prototype model meteor flash analyzer was designed, constructed, and tested. The apparatus consists of a three channel radiometer utilizing adjacent wavelength bands $<0.23\mu$; $0.26\mu>$ (silicon channel), $<0.26\mu$; $0.30>$ (magnesium channel) and $<0.30\mu$; $0.41\mu>$ (iron channel). The meteor flash analyzer is designed to determine for each meteor flash and simultaneously in three wavelength bands the maximum meteor intensity, and the time integrated meteor intensity. It is surmised that as a result of this effort, a functional and fully tested instrument is now available which can be adapted with minimal design changes to existing spacecraft. Specific missions under consideration are the Apollo Applications program, the Nimbus E mission, and a Mars mission on a spacecraft like Voyager. S.C.W.

N68-21445# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
THE CYLINDRICAL CAPACITOR AS AN ANALYZER. 2: RELATIVISTIC PART
H. Z. Sar-El Oct. 1967 31 p refs
(IA-1131)

The study of the dynamic and optical properties of the cylindrical capacitor as an analyzer for charged particles is extended to the relativistic region. The proposed analyzer is found to be absolutely unrestricted by the relativistic effect, the latter introducing some changes which do not however impair the analytical features of the device. The emission angle for which there is a second order focus is energy-dependent, shifting from $\theta_0 = 42°18.5'$ in the nonrelativistic case to $\theta_0 = 55°$ in the ultrarelativistic case. It is shown that the usual derivation of the relativistic formulae from the nonrelativistic ones by replacing the nonrelativistic potential difference by an effective relativistic potential difference is incorrect for electrostatic devices, unless this quantity is given a specifically electrostatic form, distinct from the magnetic one. The figures of merit of the analyzer concerning resolution and luminosity are comparable with those of the best magnetic spectrometers. The analyzer seems to be simpler and cheaper than the magnetic type, but calls for very high deflecting voltages, which may be a disadvantage in operation. Author (NSA)

N68-21447# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
PREPARATION AND USE OF LITHIUM-DRIFTED GERMANIUM DETECTORS
D. Srnka Aug. 1967 23 p refs
(UJV-1873)

Detailed fabrication techniques for planar and coaxial lithium-drifted germanium detectors are described. For cooling germanium detectors the small vacuum cryostat was designed. Coaxial type detector with active volume of 3.5 cm^3 was made by lithium drifting process in boiling pentane. The FWHM energy resolution with an E81OF preamplifier was 4.2 keV for 1.333 keV gamma rays with a detector bias of 1.750 V. Author (NSA)

N68-21449# Bettis Atomic Power Lab., Pittsburgh, Pa.
EFFECTIVE CADMIUM CUTOFF ENERGIES FOR FINITE CYLINDRICAL FILTERS WITH FINITE-SIZE DETECTORS. LSBR/LWBR DEVELOPMENT PROGRAM
S. S. Glickstein and W. J. Hall Nov. 1967 31 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-670) CFSTI: HC $3.00/MF $0.65

Curves and tables were compiled to aid the experimenter in evaluating cadmium-cutoff energies appropriate to the experimental

situation. Results are presented for finite cylindrical cadmium filters with an isotropic flux incident on a point detector located at the center or off the center of the filter. Finite-size detector calculations are also shown, as well as results for some cases of anisotropic incident fluxes. Author (NSA)

N68-21451# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
A SYNCHRONIZER FOR DELAYED TRIGGER OF THE OSCILLOSCOPE SWEEP FROM THE PULSES OF THE SERIES UNDER INVESTIGATION [SINKHRONIZATOR DLYA ZADERZHANNOGO ZAPUSKA RAZVERTKI OSTSILLOGRAFA OT IMPUL'SOV ISSLEDUEMYKH SERII]
N. K. Vishnevskii, V. I. Rykalin, and V. P. Khromov 1967 10 p refs In RUSSIAN
(IFVE-SEF-67-12-k)

To investigate long series of nanosecond pulses a delayed trigger circuit of the oscilloscope sweep is developed. The sweep pulses are tied to those of the series under investigation with an accuracy of less than 0.5 ns. The circuit allows one to observe any part of the series with the pulse duration up to the tenths of a second, the sweep rate being less than 10 ns/cm without a diffuse image. The circuit operates stably at a repetition frequency inside a series of more than 100 MHz. Author (NSA)

N68-21452# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
A FIVE-RAY OSCILLOSCOPE FOR MEASURING π^+ MESON LIFETIME [PYATILUCHESOI OSTSILLOGRAF DLYA IZMERENIYA VREMENI ZHIZNI π^+ MEZONA]
A. F. Dunaitsev and Yu. N. Simonov 1967 14 p refs In RUSSIAN
(IFVE-SEF-67-2-K)

A five-ray oscilloscope is described for photoregistration of pulses from counters with their subsequent amplitude and time analysis. The device allows one to have, at the same time, sweep rates from 10 to 80 ns/cm for three rays and from 0.5 up to 10 μs/cm for the remaining two rays. The linearity of the sweep is better than 0.5 and 1%, respectively. Author (NSA)

N68-21472# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GAS ANALYZERS
V. A. Pavlenko 27 Jun. 1967 280 p refs Transl. into ENGLISH of the publ. "Gazoanalizatory" Moscow, Izd. Mashinostr., 1965 p 1–296
(FTD-MT-66-12; AD-666090)

For the first time in book form are systematically described the most important physical-chemistry methods of gas analysis. A description is given of the principles of action, circuits and constructions of native and foreign gasanalytic instruments characterizing the state of this branch of instrument-making. This book is intended for scientific and engineering-technical workers concerned with instrument-making and automation of technological process and also specialists from the region of analytic instrument-making. This may be useful to students in instrument-making, chemical and metallurgical departments of higher and middle technical educational institutions taking a course on equipment and instruments of control and control of industrial processes. TAB

N68-21488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPARK SPECTROMETER FOR HIGH ENERGY PARTICLES [ISKROVOY SPEKTROMETR DLYA CHASTITS VYSOKIKH ENERGIY]
Zh. S. Takibayev 17 Jul. 1967 17 p Transl. into ENGLISH from An. Kazssr. Vestnik (USSR), no. 8, 1965 p 3–9
(FTD-HT-23-743-67; AD-666080)

After reviewing the difficulties involved in determining the energy of high-energy particles from track curvatures with ionization chambers, movable films, and other methods, the author proposes a spectrometer design consisting of several spark chambers, Fe absorbers, and scintillators. The use and operation of the spectrometer are discussed in extensive detail. Also, variations in configuration are proposed: e.g., one in which spark chambers, scintillators, and Fe absorbers are alternated in a stack. In this design the plastic scintillators or the vessels containing the scintillation liquid have a special shape to compensate for the emitted light with respect to the photomultipliers. Author (TAB)

N68-21495# North American Rockwell Corp., Anaheim, Calif. Autonetics Div.
FUNCTIONAL EVALUATION OF MULTICOLOR ELECTROLUMINESCENT STATUS DISPLAYS, PHASE 3 Final Report
John S. Frost and Carl S. Hoffman 29 Feb. 1968 34 p refs
(Contract N00014-66-C-0135)
(C8-420/301; AD-666317)

An electroluminescent display for pictorially presenting aircraft flight surface and landing apparatus configuration was designed and constructed. The ability of observers to detect errors on this display was compared to similar performance with a conventional aircraft display containing the same information. By the installation of a transparent red-emitting plate to the front of the electroluminescent panel, a third display mode, that of dynamic color electroluminescence, was established. Hue changes were effected, using standard additive mixing techniques, by varying the intensity of the electroluminescent emission. The three displays were shown to six highly trained subjects in a counterbalanced order. A random number of errors appeared on each of the 60 presentations of each display. Subjects were asked to identify each error by depressing the appropriate response pushbutton as rapidly as possible. Errors were defined as flight surface and landing gear configuration conditions inappropriate to the given mode of flight. These errors were color-cued on the color electroluminescent display. The test results indicated that performance with the electroluminescent displays tended to be superior to that with the conventional display in terms of both errors and response time. Both electroluminescent displays yielded significantly lower response times when compared to the conventional display; the color electroluminescent display yielded significantly fewer errors when compared with the conventional display. Subjects comments regarding the electroluminescent displays and their operational potential were generally favorable. Author (TAB)

N68-21522# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METRIC INSTABILITY OF AERIAL FILMS [METRICHESKAYA NESTABIL'NOST' AEROPLENOK]
T. P. Budylova and Yu. M. Formin 29 Aug. 1967 16 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, 1965 p 43–51
(FTD-HT-67-140; AD-666125)

Investigation of the deformations and the thickness variation of a number of aerial films produced in the USSR. As a result of various experiments performed, it is concluded that, when systematic deformation over a grid of coordinate marks with a spacing of 1 cm is eliminated, the residual measurement errors caused by deformation of the aerial film lie between plus or minus 2.0 and 3.5 microns, while their maximum values can reach 10 microns. It is also found that the residual measurement errors due to variation in the thickness of the aerial film, when a grid of coordinate marks 1 cm apart is used to take them into account, amount to 1.0 to 2.5 microns. TAB

N68-21574# Michigan Univ., Ann Arbor. Dept. of Physics.
A DESIGN STUDY OF A LARGE APERTURE GAS THRESHOLD CHERENKOV COUNTER USING WAVE-LENGTH-SHIFTER TECHNIQUE FOR LIGHT COLLECTION

Robert Ball Feb. 1968 25 p refs
(Contract Nonr-1224(23); Grant NSF GP-7283)
(TR-31; Rept.-03106-31-T; AD-666558)

Using as a detection surface a POPOP-coated plexiglass sheet viewed by two 6810 phototubes, a He Cherenkov counter with 10 m. of He radiator and operating at atmospheric pressure at 14,000 feet can distinguish positive-pions from p in the energy range 30 - 140 GeV with an efficiency of at least 5% plus or minus 1%. The efficiency can possibly be considerably improved by the selection of photomultiplier tubes with optimum single photoelectron pulse height distributions and by optimizing tube voltages. Although a sample of positive-pion cosmic ray events can be labelled in spite of the small detection efficiency, unless the efficiency can be improved the event rate becomes almost prohibitively small. For Cherenkov counters used in accelerator experiments, the use of POPOP-coated plexiglass sheets for a detection surface has the following merits: A uniform efficiency for photons incident over a large area of arbitrary shape; A fast rise time provided through the use of photomultiplier tubes of small photocathode area, thus enabling the use of the Cherenkov counter in fast timing. Author (TAB)

N68-21620# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
IMPROVED TEMPERATURE COMPENSATION FOR INTEGRATED PIEZORESISTIVE TRANSDUCERS
Edgar J. Evans and Steven P. De Feo Feb. 1968 34 p ref
(PA-TR-3637; AD 666211)

In this report, a new method of temperature compensation of piezoresistive transducers based on linearity of parameters is described. This new approach has resulted in a considerable simplification of the problem as compared to the original series solution. A theoretical analysis of the new method is presented and compared with the results obtained from an actual experimental transducer. Subsequently, a complete design example is given to illustrate the steps necessary in the fabrication of a temperature-compensated transducer. Since some of the components used in the fabrication process cannot be built exactly to specification, an error analysis was performed. It predicts the deviations which can be tolerated and gives the appropriate degree of compensation. Author (TAB)

N68-21647*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
APOLLO RADIATION SURVEY METER AND PERSONAL RADIATION DOSIMETER
15 Mar. 1968 110 p refs
(Contract NAS9-6287)
(NASA-CR-92048; FZK-353) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Structural and operational details are provided on the personal radiation dosimeter (PRD) and the radiation survey meter (RSM) which were designed to monitor the radiation dose resulting from exposure to solar flares and the Van Allen radiation belt. The PRD has a 0- to 1000-rad range in 0.01-rad increments and measures cobalt-60 gamma fields of less than 60 rad/h to within ± 10%, and fields greater than 60 rad/h to within 20% with a reproducibility of ± 3%. It integrates incident radiation and displays the total dose on a five-digit register. The RSM has four selectable ranges: 0 to 100 mrad/h, 0 to 1 rad/h, 0 to 10 rad/h, and 0 to 100 rad/h. The survey meter measures cobalt-60 gamma dose rates to within ± 10% of full scale for each range with ± 3% reproducibility. Radiation rate is measured on a linear meter readout. Various calibration and linearity tests of the instruments are described. Differences in response between the two devices are assessed. It is pointed out that range–energy tables indicate that the shield and outer electrodes of the detectors will absorb all electrons with energies less than approximately 0.55 Mev for normal incidence; this constitutes 45% of the P-32 beta spectrum on a particle basis. M.G.J.

N68-21656# Air Force Office of Scientific Research, Washington, D. C.
BASIC RESEARCH IN ACTION: INSIGHT. THE CHEMISTRY OF PHOTOGRAPHIC DEVELOPMENT
William D. Eckert [1967] 27 p refs
(AFOSR-67-1854; AD-666420)

To give an example of basic research of value to the Air Force, this study tracks down applications related to a contract sponsored by the Air Force Office of Scientific Research. By literature search and by interview with the investigators, Air Force users and other experts, the impact of AF 18(600)-371, Chemistry of Photographic Development, was traced. The contract itself produced publications on developer analysis that are still referenced worldwide. A means of recovering over-exposed pictures was discovered. Related applications, derived from work sponsored by numerous Air Force and DOD agencies, have provided extensive payoff to the funds invested by AFOSR from 1952-68. Author (TAB)

N68-21728# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
PROCEDURE MANUAL FOR THE DEPARTMENT OF ELECTRON MICROSCOPY. 4: THIN SECTIONING. THE ELECTRON MICROSCOPE [RICETTARIO AD USO DEL REPARTO DI MICROSCOPIA ELETTRONICA. 4. ULTRAMICROTOMIA. MICROSCOPIO ELETTRONICO]
9 Sep. 1967 77 p In ITALIAN; ENGLISH summary
(ISS-67/27) CFSTI: HC $3.00/MF $0.65

Thin sectioning procedures for preparing slides for microscopic study are presented in this manual, which also covers practices and uses of the electron microscope. Microtomic methods are outlined, and some of the accepted general procedures are covered. Various aspects of electron microscopy as well as use of other types of biological observation equipment are mentioned. Transl. by M.W.R.

N68-21738*# Rocketdyne, Canoga Park, Calif.
STUDY OF DUAL CHANNEL INFRARED SPECTRORADIOMETER SYSTEMS Interim Report
W. F. Herget 28 Nov. 1967 32 p refs
(Contract NAS8-21144)
(NASA-CR-94133; R-7296) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A dual channel infrared spectroradiometer system has been developed to furnish the spectroscopic data necessary for determination of temperature and partial pressure distributions of certain species within the exhaust of large rocket engines. The system includes an internal blackbody intensity calibration source, external radiation sources for absorption measurements, spatial and spectral scanning mechanisms, power supplies and recording apparatus. Author

N68-21747# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
USE OF THE ^{3}He PROPORTIONAL COUNTER FOR NEUTRON SPECTROMETRY [UTILISATION DU COMPTEUR PROPORTIONNEL A ^{3}He POUR LA SPECTROMETRIE DES NEUTRONS]
Henry Vialettes and Phung Le Thanh Sep. 1967 52 p refs
In FRENCH
(CEA-R-3310)

The two methods which have been mainly used for neutron spectrometry near nuclear installations are photographic emulsion spectrometry and the so-called multisphere technique spectrometry. The first method has a threshold energy of about 500 keV; this is a big disadvantage for an apparatus which has to be used for spectrometry around nuclear installations where the neutron radiation is very much degraded energetically. The second method does not suffer from this disadvantage but the results which it yields are only approximate. In order to extend the energy range of the neutron spectra studied with sufficient accuracy, the use of a

helium-3 proportional counter has been considered. This report presents the principles of operation of the helium-3 spectrometer, and the calculation methods which make it possible to take into account the two main effects tending to deform the spectra obtained which are energy absorption by the walls of the counter and energy loss of the incident neutrons due to elastic collisions with helium-3 nuclei. As an example of the application, the shape of the neutron spectrum emitted by a polonium–lithium source is given; the results obtained are in excellent agreement with theoretical predictions. Author (NSA)

N68-21770 Fraunhofer Institut, Freiburg (West Germany).
TECHNICAL TEST FLIGHT OF SPECTRO-STRATOSCOPE GONDOLA [TECHNISCHER ERPROBUNGSFLUG VON SPEKTRO-STRATOSKOP]
J. P. Mehltretter Bundesministerium Fuer Wiss. Forsch. Dec. 1967 87 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-38) CFSTI: $3.00

Described are preparations, launch, and flight of a simplified version of the balloon-borne solar telescope at Palestine, Texas. The purpose of the telescope is to measure the fine structures in the solar atmosphere by obtaining simultaneously pictures and spectra of a small section of the solar surface from a minimum altitude of 20 km. The aim of this flight was realistic testing of several critical components. The knowledge gained during the operation and the results of temperature measurements are reported and discussed. K.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-20601# Junta de Energia Nuclear, Madrid (Spain). Div. de Metalurgia.
EDDY CURRENT INSPECTION OF PIPES (TUBES) [INSPECCION DE TUBOS POR CORRIENTES DE TOUCAULT]
J. L. R. Bauza, J. Herrero, and J. Diaz Apr. 1966 28 p refs In SPANISH; ENGLISH summary
(JEN-179-DME/I-15) CFSTI: HC $3.00/MF $0.65

The experimental research work carried out to develop Eddy current testing equipment is described. Search coils with ferrite or air cores were used and the obtained results are discussed. Valuable information was gained from an improved channel in which a direct measure of the defect and the reference signal phase difference is obtained. Artificial defects used to evaluate resolution and sensitivity were produced by electro-machining and mechanical means. Finned SAP tubing was tested in a routine basis with the described equipment and the results plotted. Basic and theoretical considerations on the Eddy current testing technique are given in the last section of this report. Author (ESRO)

N68-20605 California Univ., Berkeley.
TEMPERATURE DISTRIBUTION IN AXISYMMETRIC EXTRUSION THROUGH CONICAL DIES
Taylan Altan (Ph.D. Thesis) 1966 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-4990

The properties of the extruded product, the residual stresses, and the defects that may occur can be predicted, and the mechanics of the extrusion process can be better understood if the temperature distributions in the billet before, during, and after extrusion are known. After a review of the literature, a numerical method was developed to predict the local temperatures in the billet and in the tools before the start of extrusion. The numerical method was further extended for calculating the non-steady-state temperature distributions during extrusion. Heat generation and conduction were approximated in two consecutive steps taking place during equal time increments, Δt. The temperature dependencies of the flow stress and of the thermal constants of the billet and tool materials were taken into account. The entire procedure was programmed in FORTRAN IV to facilitate its general use in analyzing extrusions with different extrusion ratios, materials, die angles, ram speeds, and friction conditions. Dissert. Abstr.

N68-20826# Materials Research Corp., Orangeburg, N. Y.
INVESTIGATION OF ELECTRON BEAM AND HOLLOW CATHODE PROCESSING OF ALUMINUM OXIDE AND RELATED MATERIALS Final Report, 15 Nov. 1966–15 Nov. 1967
Walter Class 15 Nov. 1967 43 p refs
(Contract F19628-67-C-0124)
(AFCRL-68-0004; AD-665878)

The report deals with the preparation of oxide single crystals by electron beam and hollow cathode floating-zone methods. Primary emphasis has been placed upon the development of a modified crystal growing furnace which embodies many of the principles of floating-zone crystal growth evolving from previous work. The crystal growth furnace has been completed and subjected to crystal growth experiments which reveal that high perfection crystals can be grown by this method. It is expected that this furnace will find some widespread application to the growth of many refractory compound crystals currently of interest to the solid state technology. Author (TAB)

N68-20839# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
INVESTIGATION FOR IMPROVEMENT IN DESIGN OF STAINLESS STEEL HYDRAULIC TUBING SLEEVE ASSEMBLY Final Report
A. Bold 19 Jan. 1968 18 p ref *Its* Independent Exploratory Develop. Program No. 17
(NADC-MA-6732; AD-665311)

A study to develop installation techniques for improvement of the performance of stainless steel fitting assemblies by local tubing expansion until the tubing became tight in the sleeve. This operation improves stainless steel fitting assemblies as it reduces leakage possibilities between sleeve and tubing. Further, it lowers tightening torque requirements. However in flexure study the results were less favorable. Due to the requirement for using annealed MIL-T-8504 tubing, the sleeve loosened on the tubing during repeated flexing. This caused leakage under the sleeve or tubing rupture at the ring cut. It was recommended that all stainless steel sleeve-tubing assemblies be locally expanded and that efforts be exerted to develop a sleeve for use in stainless steel flareless connectors that permits the use of MIL-T-6845 tubing. Author (TAB)

N68-20877*# North American Rockwell Corp., Los Angeles, Calif.
ROLL DIFFUSION BONDING OF SIMULATED TITANIUM S-1C Y-RING SEGMENT Final Report, 30 Jun. 1965–29 Feb. 1968
29 Feb. 1968 198 p
(Contract NAS8-20533)
(NASA-CR-61698; NA-68-133) CFSTI: $3.00 CSCL 13H

The purpose of this work was to establish design requirements and process parameters for fabricating a simulated S-1C Y-ring segment from 8Al–1Mo–1V titanium alloy for incorporation into the space vehicles. A design was established for a titanium head cylinder attachment member to be fabricated by the roll diffusion bonding process, hot contour forming, and machining; this design represents a 32% weight reduction over existing aluminum Y-rings. Subscale tests were used in developing diffusion bonding, machining, chemical milling, hot forming, and heat treatment techniques required for fabrication. Design drawings for all required tooling were prepared. A fabrication plan for two full-scale Y-ring segments was established, and the two 35-foot long segments were fabricated to form a 33-foot diameter structure typical of the S-1C booster. A 9-foot test section was cut from this structure and fully processed through finish machining, leaching, and chemical milling. Trim samples from this section were evaluated for fabrication techniques and diffusion bond integrity. K.W.

N68-20929# California Univ., Berkeley. Coll. of Engineering.
ULTRASONIC WELDING OF METALS IN VACUUM Final Report
P. F. Pfaelzer and J. Frisch Dec. 1967 65 p refs
(Contract W-7405-ENG-48)
(UCRL-13331; MD-67-3) CFSTI: HC $3.00/MF $0.65

Ultrasonic welding of copper was performed in air as well as in 10^{-10} torr vacuum environment. Adhesion between contacting surfaces was greatly enhanced by the vacuum environment, as shown by the higher coefficients of adhesion. Test results show that the strength of welds depends on the interfacial areas which have not slipped relative to each other. Microscopic details of the weld topography show a recurrence of distinct areas which affect the weld integrity. In the presence of oxidation, slip areas are not considered as a useful condition for high bond strength. Author (NSA)

N68-20950# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ULTRASONIC METHOD FOR NONDESTRUCTIVELY DETECTING RADIATION INDUCED EMBRITTLEMENT IN PRESSURE VESSEL STEELS
David O. Hunter 16 Oct. 1967 24 p refs Presented at the Conf. on Incipient Failure Diagn. for Assuring Safety and Availability of Nucl. Power Plants, Gatlinburg, Tenn.
(Contract AT(45-1)-1830)
(BNWL-SA-1467; CONF-671011-3)

A preliminary report is presented on the use of the critical angle method of ultrasonic testing of radiation induced embrittlement of stainless steels used in reactor pressure vessels. At the present stage of the investigation it has not been determined if the method is capable of identifying the extent of damage simultaneously present such as neutron irradiation, fatigue, creep, and residual stresses. NSA

N68-20955# New York Univ., N. Y. Research Div.
GASKETING MEDIA AT ULTRA-HIGH PRESSURE
Martin Prince, Yoshiyuki Okamoto, and B. Rugg (M.S. Thesis) May 1967 180 p refs
(Contract AF 19(628)-5990)
(AFCRL-67-0502; SR-1; AD-665859)

The development of new materials to be used as solid pressure transmitting media in ultra-high pressure, high temperature apparatus equipped with x-ray facilities has been investigated. The ultra-high pressure apparatus used was the tetrahedral anvil press designed by Hall. Four composite materials were found to be superior to all others tested: (1) 70% amorphous boron, 30% polyphenylene oxide; (2) 80% amorphous boron, 15% polyphenylene oxide, 5% Nalcon; (3) 80% lithium hydride, 20% polyphenylene oxide; and (4) 90% lithium hydride, 10% polyphenylene oxide. The composites were tested for their stability at high temperature, at atmospheric pressure under inert conditions and at a pressure of 40 kilobars in a tetrahedral anvil press. High pressure calibration experiments were performed for each composite by utilizing resistance transitions in bismuth I to II and II to III at room temperature. The materials have also been rated as effective gasketing materials by comparison to the standard material, pyrophyllite. Author (TAB)

N68-20963# Los Alamos Scientific Lab., N. Mex.
MICRORADIOGRAPHY OF PYROCARBON-COATED $^{238}PuO_2$ MICROSPHERES TO DETERMINE COAT THICKNESS
R. A. Morris and R. D. Strong 22 Dec. 1967 6 p
(Contract W-7405-ENG-36)
(LA-3814) CFSTI: HC $3.00/MF $0.65

A method of microradiographing pyrocarbon-coated PuO_2 microspheres without contaminating the plate and the radiographic equipment is described. Resolution of the order of one micron has been obtained. The equipment and the technique used are discussed. Author (NSA)

N68-20970*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.
ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 2: CONNECTOR CONCEPT STUDIES Final Report, 5 Jul. 1963–30 Jun. 1967
L. G. Gitzendanner 23 Aug. 1967 93 p refs
(Contract NAS8-11523)
(NASA-CR-93926; S-67-1157, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Various joining techniques and concepts were analyzed as part of a program to develop zero leakage ducts and tube connections. An investigation of the ultrasonic welding process showed that ultrasonic equipment is not currently available for making the seal for zero leakage connections. Explosive forming techniques were employed to make tube joints using aluminum tubing and a solid metallic mandrel to keep the tube from collapsing. The joints were pressure tight when tested up to the yield point and metallographic photos showed welding occurred in the joint area. Good leak tight joints with mechanical strength were fabricated using the magnetic forming process. A single formulation of adhesive was tested on a 10° tapered joint and resulted in a strong zero leakage connection. From the point of cleanliness, fusion welding is well suited for permanent duct joints. Lined tubes for handling fluids not compatible with metals were considered. It appears that such joints can be made. R.N.A.

N68-20971*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.
ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 4: NEW CONNECTOR DESIGNS AND TESTING Final Report, 5 Jul. 1963–30 Jun. 1967
J. P. Laniewski 28 Aug. 1967 187 p refs
(Contract NAS8-11523)
(NASA-CR-93912; S-67-1157, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Omega seal, diffusion bonded, pressure welded, and high temperature connectors were tested under conditions of temperature, pressure, shock, and vibration. The omega seal showed no leakage during the environmental tests. The making of the weld was a straightforward operation and the Hastelloy "W" washer technique produced a sound weld. The diffusion bonding process is simple and practical for field operation. The process produced a high strength bond and a leak-tight hermatic seal with excellent integrity. The joint was partially ruptured by a bending stress of 35,000 psi. Consistent high quality pressure welds can be obtained if the die projection width is twice the thickness of one of the

sheets to be welded. A 70% deformation was required to produce a good weld. Die concentricity must be maintained for a leak-tight joint. The high temperature separable connector remained leak-tight during and after the tests. The creep design properties were also demonstrated. R.N.A.

N68-20974*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 1: FUNDAMENTAL INVESTIGATIONS Final Report, 5 Jul. 1963–30 Jun. 1967

J. A. Bain and J. P. Laniewski 15 Mar. 1967 180 p refs
Prepared in part by Battelle Mem. Inst., Columbus, Ohio
(Contract NAS8-11523)
(NASA-CR-93925; S-67-1157, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Fundamental leakage and structural studies of fluid connectors and seals are reported. Specific areas of concentration included the following: biaxial stress relaxation; optical studies of seal interface contact; leak detection and evaluation of seal parameters which affect leakage; and creep studies for high temperature connector design. Specific conclusions derived from these studies were: (1) seal material exhibits definite relaxation with combined high normal loads and relative lateral displacement between seal faces; (2) greatest seal relaxation occurs in the first few cycles of relative movement; (3) with optical test equipment, strong reflections are received from areas on the seal which are within less than 1 microinch of the contact; weaker, but recordable reflections are obtained from areas up to 2 microinches from true contact; and no recordable reflections are obtained from areas over 2 microinches from true contact; (4) hydrogen sulfide can be effectively used as a tracer gas to determine leak paths, and in most cases, these paths can be observed optically; (5) six aluminum gasket tests and six teflon gasket tests indicated a high degree of repeatability; (6) seal widths can be made as narrow as possible to utilize lower total loads (for a given mean seal diameter); (7) the portable nuclei detector cannot detect all gases, but many gases which could be used to detect a leak, can be combined with other gases or with water vapor to form nuclei. S.C.W

N68-20976*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.

ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 5: TUBE CONNECTOR DESIGN PRINCIPLES AND EVALUATION Final Report, 5 Jul. 1963–30 Jun. 1967

J. A. Bain and J. P. Laniewski 15 Jul. 1967 67 p
(Contract NAS8-11523)
(NASA-CR-93924; S-67-1157, V. 5) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Presented are: (1) an evaluation of the principles of connector testing; (2) a design evaluation of commercial connectors; and (3) an assessment of design rules for threaded connectors. Also included are results of studies of leak detection involving voids and leakage resistance in series; and test and assembly description for commercial connectors. S.C.W.

N68-20977*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.

ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 6: X-CONNECTOR FEASIBILITY STUDIES Final Report, 5 Jul. 1963–30 Jun. 1967

J. A. Bain Sep. 1967 88 p refs
(Contract NAS8-11523)
(NASA-CR-93923; S-67-1157, V. 6) CFSTI: HC $3.00/MF $0.65 CSCL 13E

The feasibility of the production design of a half inch X-connector for 4500 psi service was demonstrated. The performance of these connectors was evaluated with regard to room temperature leakage, proof pressure, vibration at room temperature, burst pressure, tensile load, long term leakage at room temperature, thermal shock, low temperature leakage, high temperature leakage, and simultaneous high temperature vibration and leakage. In developing the production design it is recommended that continuing emphasis be placed on the vibration resistance and sealing integrity of the tube-to-sleeve swage. In testing of 26 connectors, tube swage was the only design feature which did not perform perfectly; however, it is surmised that problems induced by tube-to-sleeve swage are not insurmountable, since imperfect tube-swage performance in feasibility tests arose either from correctable flaws, self healing leaks, or poorly monitored environmental conditions. It is suggested that these problems can be most easily resolved through the application of a trial and error process in designing the tube-to-sleeve swage tool. It is further recommended that production design be accompanied by the development of swaging tools for field use since the collar swage tool, in particular, was never intended for field use and is unsuitable for such in its present form. S.C.W.

N68-20978*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.

ZERO LEAKAGE DESIGN FOR DUCTS AND TUBE CONNECTIONS FOR DEEP SPACE TRAVEL. VOLUME 3: GUIDE IN SELECTING DUCT, TUBING AND GASKETING MATERIALS FOR SPACE VEHICLES AND MISSILES Final Report, 5 Jul. 1963–30 Jun. 1967

R. L. George 1 Jul. 1967 96 p refs
(Contract NAS8-11523)
(NASA-CR-93927; S-67-1157, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Reported is a guide manual which was designed to aid designers confronted with the selection of a tube or duct material for missile, rocket, and space vehicle propellant handling and storage applications. The manual can be used to (1) determine if a given material is satisfactory for a given set of conditions; and (2) search for new material for a given set of requirements. Data on material properties, limitations, and compatibility are included. Physical and mechanical properties are given for a specific form, composition, temper, and heat treatment. Material limitations due to temperature and compatibility with propellants are presented in chart form. Also included is information describing the behavior of materials in a corrosive environment and data is presented pertinent to the selecting of materials for a propellant handling system. Information is valid where: (1) there is no flow; (2) atmospheric pressure and room temperature prevail; and (3) the environment is nuclear free. S.C.W.

N68-21011# Rensselaer Polytechnic Inst., Troy, N. Y.

PASSIVATION OF CREVICES DURING ANODIC PROTECTION

W. De Wayne France, Jr. and Nobert D. Greene Feb. 1968 25 p refs
(Contract Nonr-591(17))
(TR-4; AD-665788)

The protection of crevices is an important problem in the application of anodic protection. Theoretical analyses and experimental studies with a special crevice assembly show that the crevice-passivating ability of a system is controlled by electrolyte characteristics, crevice geometry, and the electrochemical behavior of the protected metal. Author (TAB)

N68-21062 Ohio State Univ., Columbus.

FORCES INVOLVED IN THE AXISYMMETRIC EXTRUSION OF METALS THROUGH CONICAL DIES

Cyril Marvin Pierce (Ph.D. Thesis) 1966 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6357

Numerous billets of AISI 1018 steel at 1800°F and OFHC copper at 800°F were direct extruded on a 700 ton horizontal press in order to determine the effects of such process variables as reduction ratio, billet length, lubrication condition, and die angle on the forces involved in the operation. A unique measurement system was employed, which quantitatively determined the deformation force at the die as well as the total required extrusion force on the stem. The total extrusion force increased as the billets were lenthened, but the effect was less significant with lubricated specimens. The container friction force was greatly reduced, thereby extending the capabilities of the press, whenever a steel billet was coated with Corning 0010 glass or Fiske 604 was swabbed in the container liner prior to a copper extrusion. The deformation forces and the deformation pressure-flow stress ratios increased linearly with the reduction ratio but did not extrapolate to zero as the reduction ratio approached one. Dissert. Abstr.

N68-21074# Teledyne Materials Research Co., Waltham, Mass.
DESIGN CRITERIA FOR HIGH-PRESSURE HIGH-TEMPERATURE BOLTING: STATE-OF-THE-ART SUMMARY AND PROGRAM RECOMMENDATIONS
W. E. Cooper, R. Widmer, J. A. Signorelli, and R. F. Brodrick Jul. 1967 66 p refs
(Contract AT(30-1)-3660)
(NYO-3660-1) CFSTI: HC $3.00/MF $0.65

The next generation of power-producing nuclear reactors is expected to operate at higher temperatures than reactors now in operation or under construction. These conditions will require that bolted closures in the systems be designed to operate under conditions not presently covered by ASME Codes. It is, therefore, necessary that steps be taken to extend the Codes to meet these new conditions. Surveyed are: 1) the anticipated needs of the nuclear industry, 2) the availability of metallurgical data which would be required for codfication to meet the anticipated needs, and 3) the status and availability of stress analysis and methods and design criteria to apply to the new conditions. It is found that closure temperatures up to 1300°F and pressures up to 4000 psi may be encountered. It is also found that, although creep data for bolting materials under consideration are available, stress-relaxation data (of particular importance here) are very meager. Further, methods for converting creep data to stress relaxation data are unreliable. A specific program for the collection of required data on prospective high-temperature bolting materials is recommended. These data would be used in the selection of specific materials and the ultimate codification for the anticipated reactor operating conditions. Author (NSA)

N68-21134# California Univ., Livermore. Lawrence Radiation Lab.
PRODUCTION OF SHAPED ARTICLES FROM SINTERED HIGH-PURITY CALCIUM FLUORIDE OF NATURAL AND SYNTHETIC ORIGIN
R. Wlodarski Mar. 1967 7 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 9, 1964 p 493–496
(UCRL-TRANS-10193) CFSTI: HC $3.00/MF $0.65

The experiments indicate that natural calcium fluoride is the best raw material for the production of sintered shapes. It has a high bulk density (1.7 g/cm^3) and a shrinkage of not more than 3 to 4%. Preliminary firing at 800°C is necessary to avoid spalling of the resulting articles. Synthetic calcium fluoride has a low bulk density (1.01 g/cm^3) and very high shrinkage (up to 40% on sintering at 1100°C), and requires a different method if it is to be made into shaped articles. Hence each material requires a specific procedure. It may be concluded that shaped products of various form and size can be made from sintered calcium fluoride if the described conditions are maintained. Author (NSA)

N68-21196# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
WELDING OF MONEL AND Cu-70–Ni-30: CAST-PIN-TEAR AND HOT-DUCTILITY TESTS
G. E. Grotke Jun. 1967 34 p refs
(Contract NObs-90029)
(WERL-0029-4) CFSTI: HC $3.00/MF $0.65

Results of a continuation of a program to investigate the applicability of Cast-Pin-Tear Test and Hot-Ductility Test techniques to the problem of weld-zone cracking in Monel and Cupro-Nickel alloys are reported. Of thirteen commercial materials tested, six materials (three 70 Cu–30 Ni pipes and three Monel weld metals) were known to have poor welding characteristics. In four instances, the inferior performance of these materials was confirmed by either direct or indirect weldability tests. Hot cracking in the problem Cu–Ni pipe materials is attributed to extremely high phosphorus content. Results of indirect tests of weld metals do not provide a basis for evaluation of these materials. Author (NSA)

N68-21201# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DEVELOPMENT OF A BEARING SYSTEM FOR THE DESPUN ANTENNA OF A SPINSTABILIZED SATELLITE. PART 1: BASIC INVESTIGATIONS [ENTWICKLUNG EINES LAGERS FUER DIE ENTDRALLTE ANTENNE EINES SPINSTABILISIERTEN SATELLITEN. TEIL 1: GRUNDLEGENDE UNTERSUCHUNGEN]
M. Granzow, G. Hauser, and H. Rieger Bundesministerium fuer Wiss. Forsch. Oct. 1967 112 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-33) CFSTI: HC $3.00/MF $0.65

This paper describes the investigations on components of a bearing system suitable for space application. Various bearing types, combinations of materials, lubricants and lubrication methods are tested under simulated environmental conditions. The result of these investigations lead to the selection of the most appropriate components of a bearing system for a mechanically despun antenna of a spin stablized communication satellite. Author

N68-21207# Los Alamos Scientific Lab., N. Mex.
SODIUM PUMPS IN THE LOS ALAMOS 2000-KILOWATT SODIUM TEST FACILITY
B. J. Melton 15 Aug. 1967 13 p
(Contract W-7405-ENG-36)
(LA-3782) CFSTI: HC $3.00/MF $0.65

Design and performance data for two sodium pumps used in the 2000-kW sodium test facility at the Los Alamos Scientific Laboratory are discussed. These were multistage centrifugal pumps with sodium-lubricated hydrodynamic shaft bearings and oil-lubricated mechanical face seals. The primary pump was operated for 11,920 hr with no down time for maintenance after the first 2 weeks of operation. The secondary pump was operated for 13,374 hr with no down time for maintenance. Postoperational inspection of secondary pump components revealed no undue wear or evidence of incipient failure. Author (NSA)

N68-21214# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
ELECTROFORMING OF THIN-WALLED MODELS FROM NICKEL [GALVANOPLASTISCHES HERSTELLUNGSVERFAHREN DUENNWANDIGER MODELLE AUS NICKEL]
G. Rohde Aug. 1967 35 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-94) CFSTI: HC $3.00/MF $0.65

Thin-walled models are a prerequisite for obtaining localized heat transfer data. The present work describes the use of nickel electrodeposition to produce thin-walled, heat resistant models for measuring heat transfer and temperature distribution in the hypersonic vacuum wind tunnel of this facility. Electrodeposition was

considered after difficulties were encountered in the mechanical manufacturing of models with wall thicknesses between 0.1 to 0.3 mm. Several types of electrolytes are compared, and a method for the electroforming of models using the nickel–sulfamate bath is described in detail. K.W.

N68-21218# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

DEVELOPMENT OF A BEARING SYSTEM FOR THE DESPUN ANTENNA OF A SPINSTABILIZED SATELLITE. PART 2: LABORATORY INVESTIGATIONS AND DEVELOPMENT OF SPECIFICATIONS [ENTWICKLUNG SPINSTABILISIERTEN SATELLITEN. TEIL 2: LABORVERSUCHE UND ERARBEITUNG VON SPEZIFIKATIONEN]

M. Granzow, F. Leiss, O. Stuckmann, and R. Vaeth Bundesministerium Fuer Wiss. Forsch. Oct. 1967 51 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.

(BMwF-FB-W-67-34) CFSTI: HC $3.00/MF $0.65

Power input, variations of operating properties and the consumption of lubricant are the most important criteria for the applicability of bearings under environmental conditions. These parameters are determined during endurance tests in vacuum with an oil vapor lubricated bearing system for the mechanically despun antenna of a spinstabilized communication satellite. The forces and moments acting on the bearing during the operation within the satellite are calculated. Author

N68-21221*# Rocketdyne, Canoga Park, Calif.

FABRICATION TECHNIQUES FOR SHROUDED TITANIUM IMPELLER Quarterly Progress Report, Period Ending 31 Mar. 1968

N. A. Edlebeck 31 Mar. 1968 32 p

(Contract NAS8-20761)

(NASA-CR-61712; LAP-68-180; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Effort on fabrication techniques of a shrouded titanium impeller was directed toward successful bonding of a simulated impeller sample, and fabrication of the full scale impeller pre-bond assemblies. Two additional plasticity test specimens were pressed bringing the total to three. These tests indicated that a temperature of about 1850 degrees F with a pressure of approximately 2500 psi appears to yield the best bonding conditions for 5 Al-2.5 Sn titanium alloy. Author

N68-21225# General Electric Co., Schenectady, N. Y. Research and Development Center.

BIBLIOGRAPHY ON REDUNDANCY

P. E. Albrecht Oct. 1967 43 p refs

(Rept.-67-C-397)

A program to collect, classify, and analyze the literature on redundancy is being conducted by the Research and Development Center Reliability Branch. The program consists of three phases: literature search and bibliography; review and classification of literature; and critical analysis of specific design techniques or analytical methods. The first phase has been completed, and the resulting bibliography is contained in this report. Emphasis was placed on obtaining the most recent references and on providing complete source information, including accession numbers of abstract bulletins (e.g., STAR, IAA) where abstracts of the primary reference as well as additional source information can be obtained. Author

N68-21226*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF CRYSTAL STRUCTURE, ORIENTATION, AND SOLUBILITY ON ADHESION AND SLIDING FRICTION OF METAL SINGLE CRYSTALS IN VACUUM

Donald H. Buckley Washington Apr. 1968 22 p refs

(NASA-TN-D-4347; ASTM-STP-431) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An investigation was conducted on the relation of friction to the adhesion or cohesion of metals in vacuum. Metal single crystals were used to determine planes, surface energy, work hardening, and crystal structure on friction and adhesion. The following characteristics were examined: (1) atomic plane matching across an interface, (2) the effect of plane atomic density, (3) orientation of coupled metals, (4) mutual solubility, and (5) the effect of crystal structure. The metal couples examined included the copper plane pairs: (100) on (100), (110) on (110), and (111) on (111), all three pairs matched planes and directions; and (110) on (100) and (111) on (100). The (111) plane of copper was also examined in contact with planes (0001) of cobalt, (111) of nickel, and (110) of tungsten. The (0001) plane of cobalt was also studied in contact with itself. The results of this investigation indicate that adhesion is markedly increased by small amounts of unidirectional sliding of the surfaces in contact. The adhesion measurements correlated with the friction coefficients; high friction coefficients were always accompanied by high adhesive forces. Author

N68-21232*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VARIOUS MODES OF WEAR AND THEIR CONTROLLING FACTORS

Edmond E. Bisson Washington 1968 33 p refs To be presented at 71st Ann. Meeting of the STM, San Francisco, 23–28 Jun. 1968

(NASA-TM-X-52426) CFSTI: HC $3.00/MF $0.65 CSCL 11

As an understanding of the basic mechanisms of wear permits alleviation of the causes, the various modes of wear are identified. These are: (1) Adhesive wear involves adhesive forces which form cold welds at the contacting asperities. During relative motion, shear takes place at the welds, with the shear strength influenced by contamination. (2) Abrasive wear involves damage to soft surfaces by a hard surface, and is affected by hardness, work hardening, crystallite orientation, and elastic modulus of the contacting surfaces. (3) Corrosive wear involves reaction of the surfaces with the atmosphere. (4) Surface fatigue occurs by local pitting or flaking. Fretting is defined as a combination of adhesive, corrosive, and abrasive wear. The influence of crystal structure on friction and wear is discussed, and comparisons are drawn between hexagonal and cubic structures as well as between single crystal and polycrystalline materials. It is pointed out that all modes of wear lead to loss of dimensional tolerances, high operating costs, and excessive expense for replacements. M.G.J.

N68-21241*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MACHINING AND GRINDING OF ULTRAHIGH-STRENGTH STEELS AND STAINLESS STEEL ALLOYS

C. T. Olofson, J. A. Gurklis, and F. W. Boulger Redstone Arsenal, Ala. Redstone Sci. Inform. Center [1968] 217 p refs Prepared by Battelle Mem. Inst.

(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))

(NASA-SP-5084; RSIC-501) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The state of the art of metal-removal operations for stainless and ultrahigh-strength steels is presented. It describes the methods currently employed for conventional machining, grinding, electrolytic, electric-discharge, and chemical-machining processes. The precautions that should be taken to avoid troubles resulting from the characteristics typical of these alloys are pointed out. Nine machining, two grinding, two cutting, and three unconventional metal-removal operations are discussed separately. Other sections discuss the classification of these alloys and their general response to machining variables. Author

N68-21273# Universidad Autonoma de San Luis Potosî (Mexico).
ANALYSIS, CONTROL AND DESIGN OF A MECHANICAL SYSTEM SUBJECT TO VIBRATIONS [ANALISIS, CONTROL Y DISENO DE UN SISTEMA MECANICO SUJETO A VIBRACIONES]
Miguel Angel Esparza Aranda (Ph.D. Thesis) 1967 157 p refs In SPANISH

The discussion begins with a definition of vibrations, how they originate, and their principal causes, as well as their classification for study. The vibrations are analyzed according to this classification and the manner in which they should be studied. Attention is given to different methods used in solving the vibration problems according to the precision required and the time and means available. Known methods that are used to control the vibrations when they can not be avoided in the design, due to factors of cost and manufacture, are described. The application of isolators to control the vibrations in an internal combustion machine is discussed. The more important instruments used in the measurement of vibrations are described. Conclusions derived from the study are given.
Transl. by R.N.A.

N68-21284# Royal Aircraft Establishment, Farnborough (England).
A TECHNIQUE FOR STUDYING HIGH VELOCITY DRAWING IN POLYMERS
G. W. H. Stevens and F. C. Bluett Aug. 1966 30 p refs
(RAE-TR-66262) CFSTI: HC $3.00/MF $0.65

The principle of elastic relaxation is considered as a technique for drawing polymers at high velocities. The theory is worked out and some tests are described in which skeins of low density polyethelene filaments have been drawn using some heat-set terylene webbing as the elastic. These tests, in which polythene was drawn at a velocity of about 50 feet per second at a temperature of about 18°C, demonstrated that the technique is feasible. Comparison with the theory suggests that the force to draw at this speed is about twice that measured at very slow rates of drawing.
Author

N68-21328# ManLabs, Inc., Cambridge, Mass.
HIGH PRESSURE HOT PRESSING OF REFRACTORY MATERIALS
David Kalish and Edward V. Clougherty Jan. 1968 37 p refs
(Contract Nonr-4262(00))
(AD-665315)

The densification of powdered refractory materials by hot pressing at high pressures and high temperatures provides a means of preparing high purity, fine-grained fully dense microstructures. Pressures of the order of 100,000 psi greatly enhance consolidation processes as compared to conventional hot pressing or pressureless sintering. Densification of refractory borides, carbides, oxides and metals is achieved at relatively low temperatures within 10 minutes. The closed high pressure hot pressing system and low temperatures are particularly important for materials subject to preferential vaporization of one component, highly reactive materials, or limiting grain growth of submicron powders. The roles of fabrication temperature, fabrication pressure and powder degassing procedures on high pressure hot pressed microstructures are considered in detail. Techniques are discussed for controlling the stoichiometry and phase distribution in high pressure hot pressed microstructures formed from reactive powder mixtures.
Author (TAB)

N68-21349# Calif. Univ., Livermore. Lawrence Radiation Lab.
COMPACTING OF POWDERS
P. Vergnon Jun. 1967 34 p refs Transl. into ENGLISH from CEA-BIB-70 Rept.
(UCRL-TRANS-10186; CEA-BIB-70) CFSTI: HC $3.00/MF $0.65

Several mechanisms can be invoked to explain the variation of the volume of powder when it is compacted, notably the pressing into contact of the particles, their sliding over one another, their elastic or plastic deformation, and their fragmentation. Several equations have been proposed to connect the apparent volume of a compact with the applied pressure. The experimental verification of these equations has generally involved compacting of the powders whose particles have been relatively coarse (of dimensions greater than a micron). However, study of the compacting of alumina microspheres has shown that the most generally accepted equations did not accurately portray the results obtained, except for Kawakita's equation. It is concluded that during compacting alumina microspheres behave like infinitely hard particles, and that (for pressure less than 4 tons/cm^2) they do not undergo any appreciable fragmentation of plastic deformation. In addition, it was also demonstrated that the coefficient of friction depended on the particle size.
NSA

N68-21423# Bhabha Atomic Research Centre, Bombay (India).
DIFFUSION BONDING IN VANADIUM AND ZIRCONIUM
S. K. Vermani, S. P. Murarka, and R. P. Agarwala 1967 10 p refs
(BARC-303) CFSTI: HC $3.00/MF $0.65

The feasibility of using vanadium as coating to protect zirconium from hydrogen embrittlement in organic cooled reactors was investigated. The process for diffusing the vanadium to the zirconium is described, and the diffusion between the two materials is analyzed.
B.S.D.

N68-21429*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELDING OF PRECIPITATION-HARDENING STAINLESS STEELS
J. J. Vagi, R. M. Evans, and D. C. Martin [1968] 194 p refs Prepared by Battelle Memorial Inst.
(Contract DA-01-021-AMC-11651(Z))
(NASA-SP-5087; RSIC-598) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The state of the art of the welding of precipitation-hardening stainless steels is reviewed. Welding preparations, specific welding processes, welding dissimilar metals, and joint quality are discussed.
Author

N68-21446# Bendix Corp., Kansas City, Mo.
ZIPPERED MANDRELS
V. L. Willerton Dec. 1967 9 p
(Contract AT(29-1)-613)
(BDX-613-99) CFSTI: HC $3.00/MF $0.65

The zippered mandrel is a removable mandrel designed to hold cylindrical or elliptical forms for machining, coating, and forming. The zipper permits mandrel removal without disturbing the final product.
Author (NSA)

N68-21588# Naval Applied Science Lab., Brooklyn, N. Y.
FATIGUE PROPERTIES OF UNCOATED AND GALVANIZED IMPROVED PLOW STEEL WIRES
16 Jun. 1967 9 p
(TM-6; AD-665976)

Fatigue evaluations on uncoated and galvanized improved plow steel (I.P.S.) wires were conducted in a rotating beam wire fatigue tester to determine if data obtained in the wire fatigue tester could be useful in connection with wire rope investigations.
TAB

N68-21592# Franklin Inst., Philadelphia, Pa. Research Labs.
EVALUATION OF THE LIFE MARGIN OF OSCILLATING NEEDLE ROLLER BEARINGS Final Report
John H. Rumbarger Feb. 1968 61 p
(Contract N00156-67-C-2452)
(F-C2077; AD-666588)

The life-margin of oscillating caged needle roller bearings is determined in an explicit non-statistical manner. Life-margin is

the difference between the first macroscopic evidence of spalling fatigue and the end of useful bearing life. The bearings were life tested under service conditions closely duplicating those in helicopter rotor vertical and horizontal hinge pin locations. Author (TAB)

N68-21613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED ELECTRODYNAMIC RIBBON VALVE FOR PERIPHERAL ADMISSION OF GAS [UYSTRODEYSTVU-YUSHCHIY LENTOCHNYY ELEKTRODINAMICHESKIY KLAPAN DLYA PERIFERICHESKOGO NAPUSKA GAZA]
N. V. Filippov, L. G. Golubchikov, and V. D. Ivanov 14 Jul. 1967 22 p refs Transl. into ENGLISH from the publ. "Institut Atomnoy Energii Im. I. V. Kurchatova" (Moscow), 1966 p 1–15
(FTD-MT-24-87-67; AD-666143)

Due to the need for a speedier valve for admitting gas into a vacuum chamber in connection with many plasma experiments an investigation is made of a new type of electrodynamic valve. The valve itself is a thin metal ribbon, drawn through an insulating layer against the cylindrical section of the vacuum chamber into which a pulse inlet of gas occurs. The ribbon covers a narrow annular slot (a chain of small holes). Vacuum sealing of the valve is attained by tightening the ribbon by means of a tension device. The valve opens when the ribbon is pulled away by a strong magnetic field. The article describes construction of the valve and the determination of its mechanical characteristics. Author (TAB)

N68-21624# Columbia Univ., New York. Lubrication Research Lab.
ON RUBBER-TO-METAL BONDING TECHNIQUES WITH REFERENCE TO COMPLIANT SURFACE BEARINGS
Glenn K. Rightmire Nov. 1967 52 p refs
(Contract Nonr-4259(06))
(Rept.-10; AD-664670)

The report discusses the rubber-to-metal bond as formed under vulcanization. It describes the types and nature of the bond along with characteristic strengths. A detailed bonding procedure, based on the experience gained in the compliant-surface bearing study at Columbia, is outlined, intended as guide for the manufacture of compliant surface bearings. Author (TAB)

N68-21683*# Sterling (Walter V.), Inc., Los Altos, Calif.
STUDY AND DEVELOPMENT OF NONDESTRUCTIVE WELD INSPECTION TECHNIQUES, PHASE 1 Final Report
Mar. 1968 118 p refs
(Contract NAS2-4166)
(NASA-CR-73207) CFSTI: HC $3.00/MF $0.65 CSCL 13H

In order to devise a nondestructive test (NDT) system for determining weld quality, three techniques were selected and used in combination. These are weld pulse voltage monitoring to determine the variation in resistance through the weld joint while the weld is being made; indirect measurements of the thermal energy generated during weld formation from the infrared radiation yield produced during the welding process; and the correlation between the dynamic setdown occurring during the weld and weld quality. The development of instrumentation for measuring these welding attributes is described. Weld acceptance criteria are defined, and details are given on the experiments which were conducted under closely controlled welding conditions with common welding errors purposely introduced to produce faulty welds. An NDT-related bibliography is included. M.G.J.

N68-21757# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
INVESTIGATION OF SOLID FILM LUBRICATED AIR BEARING TURBINE AT 80,000 RPM
William Capece and J. P. Carini 9 Feb. 1968 39 p refs
(NADC-MA-6809; AD-666291)

An air cycling machine designed to function at speeds of 80,000 rpm on hydrostatic gas bearing lubrication was inoperable at speeds above 55,000 rpm. Redesign of the rub shoes and rotor shaft utilizing the preferential Mo-MoS2 principle resulted in operation at the maximum design speed of 80,000 rpm and further established the advantage of a hybrid system of air bearings and solid film lubricant. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-20630 Iowa State Univ. of Science and Technology, Ames.
STIMULATED COMPTON SCATTERING OF ELECTRONS BY A LASER BEAM
Roland Rufus Roskos (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-5617

A new electron diffraction unit has been designed for the observation of stimulated Compton scattering. Giant pulses in the cavity of a Q-switched ruby laser served to diffract 1640 volt electrons. The small scattering angles were measured by scanning the electrons past a slit of a scintillator detector. Theoretical demands on design of apparatus are discussed, experimental difficulties are listed, and the limitations of the apparatus are described. Many deflection events were obtained at both positive and negative scattering angles which were consistent with expectations for stimulated Compton scattering. Some experiments were attempted in which the electron deflection probabilities were observed as functions of electron beam orientation and laser power. Qualitative results indicated that measurable electron deflections occurred only when the electron beam intersected intense standing light wave planes at the Bragg angle. Dissert. Abstr.

N68-20705 Pennsylvania State Univ., University Park.
STIMULATED BRILLOUIN RADIATION EFFECTS IN GASES
Raymond Victor Wick (Ph.D. Thesis) 1966 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5982

The stimulated Brillouin scattering in gases has been discovered and investigated as a function of density and incident laser power in nitrogen, methane, and carbon dioxide. The backscattered Brillouin radiation has a convergence equal to the divergence of the incident laser beam. The spectral width of the backscattered radiation decreases to one-half or one-third the spectral width of the initial lase at minimal detection values of density and incident power. The temporal width of the backscattered radiation decreases to one-fourth or one-fifth that of the initial lase as the minimal power-density detection limit is approached. The time resolved pulses have shown that the numerous Stokes-shifted components result from an iterative amplification process. As much as 45% of the incident laser energy was backscattered with high density nitrogen gas and high intensity incident radiation. A power-density gain relationship was experimentally verified for the production of stimulated Brillouin radiation. Dissert. Abstr.

N68-20722# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LASER WITH MAXIMUM DEEP MODULATION OF RESONATOR QUALITY [LAZER Z MAKSYMAL'NOYU HLYBYNOYU MODULYUVANNYA DOBROTNOSTI REZONATORA]

M. H. Straunov, V. D. Yer'omka, and V. Y. Bonchkovs'kiy 18 Aug. 1967 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 2, 1966 p 217–218
(FTD-HT-66-554; AD-665584)

In earlier experiments Q switching was usually effected by interrupting the coupling between the active rod and only one resonator mirror; the report investigates the properties of a laser in which the coupling with both mirrors is interrupted. An estimate shows that the gain can be increased in this case to almost the theoretical 50%. Two variants of such a laser were tested. Two ruby crystals each 24 cm long and 1.25 cm in diameter were used. One crystal operated in the Q-switching mode. The ends of the crystals and the hypotenuse faces of the total-reflection prisms were coated with MgF2 and CaF2 films, respectively. The resonator comprised alternating dielectric coatings of CaF2 and ZnS on plate glass and the prism. The plate was rotated at 12,000 rpm. The focused giant pulse produced breakdown in air. Author (TAB)

N68-20798# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF LASER LINE PROFILES Semiannual Report, 1 Aug. 1967–31 Jan. 1968
M. J. Brienza, W. H. Glenn, Jr., M. E. Mack, A. J. De Maria, G. L. Lamb, Jr. et al 28 Feb. 1968 48 p refs
(Contract N00014-66-C-0344; ARPA Order 306; Proj. Defender)
(F-920479-6; AD-665780)

The report covers work performed under Contract N00014-66-C0344 for the period 1 August 1967 through 31 January 1968. Experimental results are presented on the mode-locking of an organic dye laser, the optical rectification of mode-locked laser pulses, the measurement of nanosecond fluorescent decay times, the observation of light amplification in saturable absorbers, and the generation of a 60 MHz frequency-swept, Q-switched CO2 laser pulse. An analytical solution for 2 pi and 4 pi optical pulses and a theoretical prediction of adiabatic inversion of quantum states are presented. Author (TAB)

N68-20810# San Fernando Valley State Coll., Northridge, Calif.
ANALYTICAL STUDIES PERTAINING TO THE MEASUREMENT OF LIGHT ABSORPTION IN AIR Technical Summary Report, 1 Feb. 1966–31 Aug. 1968
Bela A. Lengyel 30 Nov. 1967 62 p refs
(Contract N00014-66-C-0098; ARPA Order 306; Proj. Defender)
(AD-665674)

Experimental methods proposed for the measurement of the absorption coefficient of light in air are analyzed. The calculations are primarily intended for the 0.5 to 1.2 micron wavelength region where for certain wavelengths the absorption coefficient to be measured is estimated to be of the order of 10 to the minus 9th power/cm. (For the 10.6 microns wavelength, the absorption is larger and the scattering is less of a problem.) The effects of scattering, heat conduction, static and acoustic pressure variations are examined and are related to the problem of detecting the signals produced by the absorption of heat from the laser beam. Both pulsed and cw schemes are considered. The measurement of the static pressure rise in a narrow tube appears as a feasible, although marginal method which offers some hope of success. Author (TAB)

N68-20845# Massachusetts Inst. of Tech., Cambridge.
INVESTIGATION OF MOLECULAR GAS LASERS Semiannual Technical Summary Report, No. 1, 1 Jul.–31 Dec. 1967
Ali Javan, Mark A. Kovacs, Michael J. Kelly, and Charles K. Rhodes 9 Feb. 1968 16 p ref
(Contract N00014-67-A-0204-0014; ARPA Order 306; Proj. Defender)
(AD-665694)

The diffusion coefficient for 001 state of CO2 into CO2 is measured and is shown to be twice larger than the self-diffusion coefficient of CO2. The wall deexcitation 001 state is also determined in detail. In another experiment, the collision lifetime of 100 state, the lower laser level is measured for the first time and studied in detail. A theoretical calculation is completed dealing with details of a CO2 amplifier saturation and manifestation of Lamb dip effect. Author (TAB)

N68-20899# Los Alamos Scientific Lab., N. Mex.
FRACTIONAL-FRINGE-SHIFT LASER INTERFEROMETER
J. E. Hammel and D. L. Rode 21 Dec. 1967 6 p refs Sponsored in part by NSF
(Contract W-7405-ENG-36)
(LA-3730) CFSTI: HC $3.00/MF $0.65

The 3.39-μ radiation from the He–Ne laser was used extensively in the measurement of electron densities in pulsed plasma experiments. The lower limit on density measurements over long paths was of the order of $10^{15} cm^{-2}$ along the beam. The sensitivity of the method was increased by about one order of magnitude in a singly pulsed plasma where the chamber requires a beam path of many meters. Some of the features of the technique are similar to those used by Hooper and Bekefi in a small repetitively pulsed plasma. A known fractional fringe modulation is applied to the interferometer cavity by a sinusoidal motion of the cavity mirror driven by a speaker coil. The infrared amplitude change due to the fast plasma pulse is then compared with the show continuous modulation given by the known displacement of the oscillating mirror. The method is checked with a known fast injection of gas. The increased sensitivity is providing information on plasma densities in gun plasma experiments. Author (NSA)

N68-21197# Aeg-Kernenergieanlagen, Frankfurt am Main (West Germany).
GaAs LASER DIODE DIFFUSION INVESTIGATION AND THE ETTINGHAUSEN LASER THEORY [DIFFUSIONS UNTERSUCHUNGEN FUER LASER-DIODEN AUS GaAs UND DIE THEORIE DES ETTINGSHAUSEN-LASER]
W. Moench and G. Haacke Bundesministerium fuer Wiss. Forsch. Oct. 1967 74 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-30) CFSTI: HC $3.00/MF $0.65

After a review on semiconductor lasers a short introduction to the theory of such lasers is given and the underlying mechanisms of the GaAs p–n junction lasers are discussed. In the experimental part, the results of different diffusion techniques are presented and their influence on the laser properties of GaAs diodes are reported. Using a $ZnAs_2$–Ga source and suitable preparation techniques the threshold for laser emission can be reduced to $10^3 amp\ cm^{-2}$ at 80°K. A new type of semiconductor lasers, the "Ettingshausen laser", is theoretically investigated. The laser condition is satisfied by the deflection of carriers to one side of a homogeneous, current carrying semiconductor specimen via a perpendicular magnetic field. It is shown that such an "Ettingshausen laser" should work in exceedingly pure intrinsic InSb at room temperature at an ExB product of about $10^6 V \cdot G \cdot cm^{-1}$. Author

N68-21557# Honeywell, Inc., Hopkins, Minn. Corporate Research Center.
MECHANISMS OF LASER-SURFACE INTERACTIONS Semiannual Report
J. F. Ready, E. Bernal G., and L. T. Shepherd Nov. 1967 74 p refs
(Contract DA-18-001-AMC-104000)
(AD-666245)

This report describes experimental and theoretical investigations of the particle emission produced in a laser-surface interaction. Measurements have been made on the angular distribution of ions emitted from a tungsten target irradiated by a ruby laser at flux densities around 10 to 20 megawatts/sq cm. In the plane

perpendicular to the plane containing the incident laser radiation and normal to the target surface the number of ions emitted follows a sq cos theta distribution where theta is the angle from the normal to the target. In the plane containing the laser radiation and the target normal, most ions appear to be emitted within approximately 15 degrees of the normal to the target. The energies of ions are also maximum in the direction normal to the target and fall off as the angle from the normal increases. Calculations on a model for heating an alkali ion plasma by absorption of laser radiation indicate that runaway heating can occur at flux densities around 10 to the 9th power watts/sq cm with particle densities around 10 to the 18th power/cu cm. The magnitudes and time histories of shock waves produced in nickel and carbon targets by absorption of laser radiation have also been calculated.
Author (TAB)

N68-21582# Illinois Univ., Urbana. Antenna Lab.
COHERENCE OF LASER RADIATION
Yasar Nabi Bayazit Dec. 1967 56 p refs
(Contract AF 19(628)-3819)
(Rept.-TR-14; AFCRL-68-0035; AD-666434)

This report is intended to be a study of some of the aspects of the coherence properties of optical fields as they propagate through certain type of media. A major part of this report deals with the response of a Fabry-Perot resonator to various types of excitation.
Author (TAB)

N68-21744*# New York Univ., N. Y. School of Engineering and Science.
KINETIC THEORY OF OPTICAL MASER
H. H. Chiu Mar. 1968 44 p refs
(Grant NGR-33-016-067)
(NASA-CR-94156; F-67-8) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The kinetic theoretic study of the interaction between a coherent light wave and the polarized molecular beam at the near free molecular flow region is presented. A theory corresponding to the weak signal model is developed and the method of harmonic analysis is incorporated to study the nature of the generation of higher harmonics caused by non-linear interaction. Calculations of the first seven harmonics including D. C. components, ±w, ±2w and ±3w and the time variation of the amplitude of electric field intensity, governed by the integro-differential equations are presented. The theory is applied to the interaction of a linearly polarized wave, at near resonant frequency, and a beam whose distribution function is near Maxwellian. The condition for the self-sustained oscillation of the maser is obtained in terms of the kinetic parameters and the electric conductivity of the beam. The linear and non-linear susceptibilities are obtained as a function of the plasma dispersion function. The dispersion curves and the absorption coefficients, calculated at two different densities, reveal that the reduction in the active medium density leads to the reduction in the frequency interval for the self-sustained oscillation and also the reduction in the coefficient of negative absorption.
Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-20580 California Univ., Berkeley.
THE HIGH TEMPERATURE CREEP CHARACTERISTICS OF AN ALUMINUM-1.79 ATOMIC PERCENT MAGNESIUM SOLID SOLUTION UNDER CONDITIONS OF CONSTANT STRESS AND TEMPERATURE, AND WITH A REDUCED STRESS TREATMENT
Howard Bell (Ph.D. Thesis) 1966 92 p
(Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-5003

It was the purpose of this investigation to study the influence of solute additions on creep and the recovery of creep resistant substructures by observing the creep characteristics of an aluminum −1.79 atomic percent magnesium solid solution under similar conditions. The alloy in question was found to have an activation energy for creep of 33,000 cal/mole and a creep rate which varied with the fourth power of the applied stress. No creep recovery was observed after reduced stress treatments and this behavior was tentatively attributed to solute atom-subboundary interaction involving the formation of solute atmospheres of a few atoms thickness on the sub-boundary which inhibit their migration. A qualitative model is offered which predicts the correct trend in both pure aluminum and the aluminum-1.79 atomic percent magnesium alloy under investigation.
Dissert. Abstr.

N68-20603 Pennsylvania State Univ., University Park.
ELECTRON TRANSMISSION AND DIFFRACTION OBSERVATIONS OF THE MICROSTRUCTURE OF ALNICO ALLOYS
John Dash (Ph.D. Thesis) 1966 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-5909

A new technique for the preparation of thin films of Alnico alloys suitable for electron transmission studies has been developed. Thin films prepared by this method have been used to study the microstructure of Alnico 5 and 6 in various conditions of heat treatment. Most of the work was concerned with a characterization of the phase transformation which occurs below about 850°C in these materials. The sizes and electron diffraction characteristics of the resultant phases were determined at various stages of the transformation at 750°C for both alloys. The effect on the microstructure of a magnetic field applied during isothermal transformation at 800°C was also determined.
Dissert. Abstr.

N68-20647# Army Materials and Mechanics Research Center, Watertown, Mass.
EXPERIMENTAL DETERMINATION OF TEXTURE AND MECHANICAL ANISOTROPY OF TENSILE PROPERTIES IN COMMERCIALLY PURE TITANIUM SHEET
Anthone Zarkades and Frank R. Larson Dec. 1967 28 p refs
(AMMRC-TR-67-05; AD-665380)

An experimental program was carried out to determine the relationship between texture and the sheet tensile properties. This investigation consisted of extensive testing of eight commercially pure titanium sheets. In each case, chemical analysis, microstructure, X-ray basal pole figure, and tensile properties were determined. The tensile properties were determined at 10-degree increments from the rolling to the transverse direction. In addition to determining the conventional yield strength, tensile strength, and elongation parameters, strain gages were used to obtain Youngs modulus and Poissons ratio in both the elastic and plastic zones. The sheets investigated had very similar textures, and it was shown that definite anisotropic characteristics were present. The interrelationship between anisotropy and texture is discussed in terms of single-crystal properties.
Author (TAB)

N68-20688# Birmingham Univ. (England). Dept. of Physical Metallurgy and Science of Materials.
THERMODYNAMICS OF ALLOYS: SOLID ELECTROLYTE STUDIES OF PALLADIUM-COPPER AND PALLADIUM-TIN ALLOYS Final Technical Report Nov. 1966–Oct. 1967
J. N. Pratt and W. G. Bugden Nov. 1967 33 p refs
(Contract DA-91-591-EUC-4132)
(AD-665821)

Reversible galvanic cells employing zirconia - calcia, zirconia - magnesia or thoria - yttria solid electrolytes have been used to investigate the thermodynamic properties of palladium - copper and palladium - tin alloys. Measurements have been made over the entire ranges of composition at temperatures between 900 and 1200K. The e.m.f. data have been used to evaluate partial and integral free energies of formation and these have been combined with calorimetrically measured enthalpies in order to estimate the entropies of formation. The thermodynamic properties are discussed in relation to the electronic and structural characteristics of the phases; it is hypothesised that the thermodynamic properties of both systems are strongly influenced by effects arising from electron transfer. Author (TAB)

N68-20720 Denver Univ., Colo.
MARTENSITIC TRANSFORMATION IN Fe–Ni ALLOYS
Richard Palmer Reed (Ph.D. Thesis) 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-4792

The study of certain characteristics of martensite transformations in Fe–Ni alloys has been conducted. The composition range of the Ni varied from 36 to 28.5 w/o Ni. It was found that the martensite morphology, crystallography, and internal twinning depend on the alloy composition. In the course of this study other effects were noticed and documented. These included localized accommodation faulting of the austenite along the perimeter of martensite plates, the crystallography of surface martensite which appears in low 28–29 w/o Ni alloys, and the occurrence of deformation twins in the Fe-36 w/o Ni alloy after deformation at 76–4°K. Dissert. Abstr.

N68-20736# TRW, Inc., Cleveland, Ohio.
LITERATURE SURVEY ON THE INFLUENCES OF ALLOY ELEMENTS ON THE FRACTURE TOUGHNESS OF HIGH STRENGTH STEELS Interim Report, Jul.–Sep. 1967
E. A. Steigerwald and C. Vishnevsky Watertown, Mass. Army Mater. and Mech. Center Feb. 1968 67 p refs
(Contract DAAG46-67-C-0171)
(AMMRC-CR-67-13(F); AD-665432)

A literature survey was conducted to summarize the known effects of solid solution additions on the fracture toughness of high-strength steels. The results indicate that nickel is the singular alloy addition that consistently improves toughness while manganese has a detrimental effect. In the range of compositions usually employed, variations in the percentage of carbide formers produces no well defined change in fracture toughness. Silicon has a marked effect on retarding the tempering reactions and some results indicate that when it is added to vacuum melted 4340 a significant increase in toughness can result. At present the use of secondary hardening mechanisms in the low alloy martensitic steels has not produced any significant improvement in toughness.
Author (TAB)

N68-20801# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
FATIGUE STRENGTH-STRESS CONCENTRATION EQUATION FOR ALUMINUM ALLOY 24S-T3
L. W. Hu and W. Morales Nov. 1967 25 p refs
(Grant AF-AFOSR-127-67)
(AFOSR-67-2837; AD-665872)

A fatigue strength-stress concentration equation was obtained by statistical analysis for aluminum alloy 24S-T3 sheet specimens subjected to fully reversed axial loads at 50% probability of fracture. Author (TAB)

N68-20805# Martin Co., Denver, Colo. Research and Development Dept.
EFFECT OF VACUUM ENVIRONMENT ON THE MECHANICAL BEHAVIOR OF MATERIALS Annual Report, 1 Oct. 1966–31 Dec. 1967
Harold Shen Dec. 1967 36 p refs
(Contract AF 49(638)-1455)
(MCR-67-423; AFOSR-68-0371; AD-665868)

The fatigue and crack behavior of some commonly used metals has been examined at reduced atmospheric pressures. Work revealed that for Aluminum alloys 1100 and 7075, Armco iron, and the Ti-6Al-4V alloy, there are three stages of the relationship between fatigue life and pressure. The magnitude of the dependence on air pressure and the pressure ranges of these various stages were found to be very sensitive to the type of material and changes in cyclic frequency, temperature, and applied stress. The report discusses the experimental results and the theoretical analysis of this work and the potential impact of the results on the theory of fatigue mechanics. Author (TAB)

N68-20823# Bhabha Atomic Research Centre, Bombay (India).
STACKING FAULT PROBABILITY DETERMINATION FROM PEAK SHIFTS IN PLASTICALLY DEFORMED THORIUM
R. Krishnan 1967 16 p refs
(BARC-298) CFSTI: HC $3.00/MF $0.65

The effects of cold-work on X-ray diffraction line positions of rolled slab of thorium and of thorium filings were investigated. The importance of peak-shifts arising from residual stresses in the bulk sample is emphasized here. It is shown that the positions of higher order peaks only determine whether the peak-shifts are due to stacking faults or residual stresses. After eliminating the peak-shift due to residual stresses, the stacking-fault probability of thorium has been computed to be about 0.005. As this fault density is not significantly different from experimental error, it is concluded that thorium belongs to the group of high stacking-fault energy metals.
Author

N68-20824# Bureau of Mines, Rolla, Mo.
EFFECTS OF COBALT ON PRECIPITATION HARDENING OF AM 350 STAINLESS STEEL
Milton M. Tilman Apr. 1968 10 p ref
(BM-RI-7121)

A series of alloys was laboratory prepared by adding up to 4 weight-percent cobalt to the basic composition of type AM 350 (AISI 633) stainless steel. Aging curves were established for each alloy at 750°F, 850°F, and 950°F for lengths of time up to 100 hours. A series of annealed steels containing as much as 1 weight-percent cobalt was cold-rolled 50 percent and aged for 3 hours at 850°F. No improvement in hardness due to cobalt was observed in the steels transformed by heat treatment. Slight improvements in hardness were observed in the steels transformed by cold working. Author

N68-20893# Bhabha Atomic Research Centre, Bombay (India).
STACKING FAULTS IN COLD WORKED FILINGS OF FCC SILVER-BASE AND NICKEL-BASE ALLOYS
R. Krishnan 1967 22 p refs
(BARC-299) CFSTI: HC $3.00/MF $0.65

X-ray diffraction line profiles of cold-worked filings of face centered cubic metals are known to shift from their normal peak position, and also broaden symmetrically as well as asymmetrically depending upon the type of stacking fault present in the material. By making measurements on these three quantities in cold-worked filings of silver-base and nickel-base alloys, the individual probability

values were determined for the occurrence of growth faults, intrinsic faults and extrinsic faults. The conclusions are that in the case of silver-antimony alloys, extrinsic faults are present whereas in silver-zinc alloys and nickel base alloys they are not found. The extrinsic fault probability in Ag-5% Sb alloy is found to be as high as 0.024. Author

N68-20922# Bhabha Atomic Research Centre, Bombay (India).
THE CREEP BEHAVIOUR OF Zr-0.05 WT % Nb-1.0 WT % Cr ALLOY
S. Ray and M. L. Mehta 1967 13 p refs
(BARC-308) CFSTI: HC$3.00/MF$0.65

Among the three zirconium-base alloys, namely, zircaloy-2 and 4 and Zr-2.5 wt% Nb proposed for high temperature water service, Zr-2.5% Nb alloy has been considered as a possible substitute for zircaloy-2 because of its higher strength. Its performance as pressure tubes is, however, not quite satisfactory because of its poor corrosion resistance in the atmosphere prevailing around the pressure tubes. It has been reported that a Zr-base ternary alloy, Zr-0.5 wt% Nb-1 wt% Cr, exhibits high corrosion resistance and very low hydrogen pickup in water at 350°C and steam at 400°C. This alloy should be of great promise to nuclear technology if it could, by various heat treatments, develop good mechanical properties. With this in view, a detailed study of the effect of thermal treatments and neutron irradiation on the tensile properties of this alloy was carried out. Some of the results have been already reported. The present paper discusses the results of creep-studies on this alloy. Author

N68-20962# Bhabha Atomic Research Centre, Bombay (India).
RADIATION DAMAGE STUDIES ON Zr-0.5% Nb-1% Cr ALLOY
S. Ray and B. D. Sharma 1967 25 p refs
(BARC-300) CFSTI: HC$3.00/MF$0.65

The paper reports the effect of neutron irradiation up to an integrated dose of 1.6×10^{19} n/cm^2 (thermal) on the tensile properties of Zr-0.5% Nb-1% Cr in annealed, cold-worked and as-quenched states. The irradiation was carried out in Apsara at 50°C. The studies reveal that whereas the cold-worked, and as-quenched alloy do not exhibit any significant hardening, in this annealed states U.T.S. and 0.2% Y.S. increase by 100% and 66% respectively for a dose of 1.25×10^{19} nvt. Isochronal and isothermal recovery studies further reveal that the irradiation induced damage anneals out in 175–410°C temperature range with an activation energy of 1.5 eV. The temperature and neutron flux dependence of 0.2% Y.S. of irradiated alloy shows that hardening could be attributed to irradiation induced 'depleted Zones', as suggested by Seeger. Author

N68-20994# Phillips Petroleum Co., Bartlesville, Okla. Research Div.
EFFECT OF VANADIUM ON HOT CORROSION OF SUPERALLOYS IN MARINE ENVIRONMENT Progress Report, 1 Oct.–31 Dec. 1967
H. T. Quigg and R. M. Schirmer Jan. 1968 63 p refs
(Contract N00019-67-C-0275)
(Rept.-4956-68R; PR-3; AD-665693)

A screening program was conducted, using a high-pressure burner rig, to evaluate the effect of vanadium on hot corrosion of a turbine-blade alloy in a marine environment. Specimens of Inconel 713C were exposed for periods of up to 55 hours to exhaust gases from Phillips 2-Inch Combustor operated at 2000 F conditions with 0.40 weight per cent sulfur in a JP-5 fuel, 0.063 ppm vanadium in air, and zero and 1.0 ppm sea salt in air. The concentration of 0.063 ppm vanadium in air was equivalent to 3.8 ppm vanadium in fuel. Data from a previous investigation, in the absence of vanadium, were available and were used as the base line for the investigation. Visual appearance, specimen weight-loss and metallographic examination of representative specimens were used in evaluating the effect of vanadium on hot corrosion. Metallographic examination showed evidence of vanadium attack by penetration of the surface layer of depleted alloy; so while weight-loss can be used for evaluating the extent of attack, it may underestimate the vanadium attack. The presence of 0.063 ppm vanadium in air increased weight-loss with both zero and 1.0 ppm sea salt in air, with the attack being more than doubled. Author (TAB)

N68-21001# Wisconsin Univ., Madison.
THE EFFECT OF SURFACE TENSION ON THE SINTERING ROLE OF METAL ALLOYS Technical Progress Report
J. S. Hirschhorn 1 Dec. 1967 3 p ref
(Contract AT(11-1)-1587)
(COO-1587-2) CFSTI: HC$3.00/MF$0.65

Work on the effect of O on the sintering rates of silver was completed. No final results have been obtained on the determination of the sintering rates of various solid solution alloys, for which surface tensions are known. The alloy being investigated is the Cu–Sn system. NSA

N68-21002# Materials Research Lab., Inc., Glenwood, Ill.
DEVELOPMENT OF TEST PROCEDURES. FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS, AUGUST 1–OCTOBER 31, 1967
E. J. Ripling and P. B. Crosley 8 Dec. 1967 24 p refs
(Contract AT(11-1)-1477)
(COO-1477-9) CFSTI: HC$3.00/MF$0.65

A four-inch thick plate of A302-B steel was used for testing tensile properties. Testing was limited to a single location in the plate. Yield stress measurements at 70, 0, and −70°F are summarized. The reciprocal loading time is used as the measure of strain rate. NSA

N68-21021# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
EFFECT OF HEAT ON CHROMATE CONVERSION COATINGS USED AS PAINT PRETREATMENTS Final Report
William H. Deaver Feb. 1968 20 p refs
(CCL-246; AD-665641)

The report covers a study on the effect of the corrosion resistance provided by chromate conversion coatings used as metal pretreatments prior to painting. Chromate treated galvanized, electrolytic zinc plated steel, aluminum and magnesium panels were heated before or after painting at temperatures from 120F to 392F for periods up to one hour and subjected to salt spray testing. It was shown that corrosion resistance of painted chromate treated galvanized and electrolytic zinc plated steel is reduced whether painted before or after exposure to heat. This did not occur with treatments for aluminum and magnesium. Author (TAB)

N68-21025# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
A METHOD OF FOURIER ANALYSIS OF X-RAY PEAK SHAPES USING ONLY FIRST-ORDER PEAKS
R. L. Rothman and J. B. Cohen 22 Jan. 1968 37 p refs
(Contract Nonr-1228(20))
(TR-12; AD-665784)

A method of Fourier analysis of x-ray line broadening is presented whereby microstrains, incoherent particle sizes, and stacking fault probabilities can be calculated using only first order peaks. This approach also eliminates errors due to peak truncation and provides a method for accurate determinations of integrated intensities. Calculations based on this method are compared to results obtained using the usual method of multiple orders. Author (TAB)

N68-21031# Oak Ridge National Lab., Tenn.
COMPATIBILITY OF DISPERSION STRENGTHENED ALUMINUM WITH URANIUM MONOCARBIDE
J. T. Vernard Jan. 1968 23 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2010) CFSTI: HC $3.00/MF $0.65

A series of experiments on the compatibility between sintered aluminum products and uranium monocarbide have been performed. These experiments tested sintered aluminum products containing 10 wt % oxide against hypostoichiometric, stoichiometric, and hyperstoichiometric uranium monocarbide at 450 to 625°C. The activation energy for the growth of the reaction product layer was determined to be approximately 84 kcal/mole for 4.8 wt % C fuel and approximately 92 kcal/mole for 4.1 wt % C fuel. A survey of earlier experiments in this system is included. NSA

N68-21040 Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
THE RESIDUAL STRENGTH OF LIGHT ALLOY SHEETS CONTAINING FATIGUE CRACKS
D. Broek Apr. 1966 41 p refs Presented at the 5th Congr. of ICAS, London, Sep. 1966
(MP-241)

A survey is given of the state of the art of the residual strength problem. Criteria are presented for crack growth and fracture, which are confirmed by test results. Test data are given of systematic investigations into the effects of sheet width, sheet thickness, load release and stop holes on the residual strength. Some residual strength data of large wing panels are presented and discussed. Author

N68-21071# Centre National de la Recherche Scientifique, Paris (France).
[ON STRESS CORROSION OF STAINLESS STEELS] Quarterly Report, 1 Apr.–30 Jun. 1967
G. Chaudron 30 Jun. 1967 15 p
(Contract EURATOM-059-65-1-TEEF(RD))
(QR-18; EURAEC-1932; EUR-3756) CFSTI: HC $3.00/MF $0.65

The stress corrosion of stainless steel was studied and the influence of the structure of the steels and the effect of a noble metal such as Pt addition to the steel were determined. The part played by martensite and austenite in stress corrosion was noted. The resistance to stress corrosion of austeno–martensite steels was due to an electrochemical mechanism caused by the martensite and the electronegative protection of the austenite. The addition of Pt to a Cr–Ni type steel intensifies the process of triangular cracking in boiling solutions of magnesium chloride. Both corrosion and pitting were found to depend on the physical and chemical surface conditions. NSA

N68-21072# Vanderbilt Univ., Nashville, Tenn.
AN X-RAY DIFFRACTION ANALYSIS OF UNIAXIALLY DEFORMED Cu_3Pt
Raymond Allen Buchanan (M.S. Thesis) Aug. 1967 70 p refs
(Contract AT(40-1)-3091)
(ORO-3091-9) CFSTI: HC $3.00/MF $0.65

Results of a study to determine the overall effect of long-range order on the mechanical properties of a Cu–Pt alloy are reported. It was determined that the degree of long-range order in the thermally ordered alloy decreased with increased tensile deformation as did the effective antiphase domain size. The stress-strain curve for a disordered Cu–Pt alloy specimen indicates that cross-slip occurred during the work hardening stage. NSA

N68-21073# Vanderbilt Univ., Nashville, Tenn.
AN INVESTIGATION OF HETEROGENEOUS DISORDERING DURING THE PLASTIC DEFORMATION OF Cu_3Pt
Joseph T. Scardina (M.S. Thesis) Aug. 1967 94 p refs
(Contract AT(40-1)-3091)
(ORO-3091-8) CFSTI: HC $3.00/MF $0.65

A study of a mechanically disordered Cu–Pt alloy indicates that it has a structure different from that of thermally disordered material. It is postulated that the resistivity properties and the thermoelectric behavior of the mechanically disordered specimens might be attributed to a heterogeneous quasi-cell structure consisting of highly disordered and deformed wall segments distributed in a highly ordered relatively undeformed matrix. It was shown that the thermoelectric EMF seemed to have a definite dependance on the difference in degree of order between highly ordered and highly disordered regions. NSA

N68-21087*# Volt Technical Corp., Washington, D. C.
INVESTIGATION OF THERMAL STABILITY OF THE MICROSURFACE OF ASTRONOMICAL MIRRORS MADE OF ALLOY AMg6L WITH CHROMIUM AND NICKEL COATINGS [ISSLEDOVANIYE NA TERMOSTOYKOST MIKROPOVERKHNOSTI ASTRONOMICHESKIKH ZERKAL, IZGOTOVLENNYKH IZ SPLAVA AMG6L S KHROMOVYM I NIKELEVYM POKRYTIYEMI]
G. M. Lorentsyan 15 Apr. 1968 5 p Transl. into ENGLISH from Soobsch. Byurakansk. Obser., Akad. Nauk Arm. SSR (USSR), v. 38, 1967 p 66–71
(Contract NAS5-12487)
(NASA-CR-94043; ST-MR-0A-10700) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An investigation was made of the effect of temperature variations and of the difference in the linear expansion coefficient of alloy AMgL6, of electrolytic chromium and of chemical nickel on the quality of microsurfaces of mirrors. These mirrors were made of AMgL6 alloy with chromium and nickel coatings of various thicknesses. The experiment was carried out at temperatures of −95°, +20° +60° and +100°C. It was shown that mirrors coated with 10 to 50μ of chromium did not alter their microsurface quality. In the cases of coatings thicker than 50μ, cracks appeared on the mirror surface. Temperature variations have no effect on the quality of nickel coatings. The origin of the cracks can be explained by great internal strains in the chromium coatings. The greater the difference between the coefficient α of the coating substances and the mirror itself, the greater the inner strains that originate in the coating. Author

N68-21093# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
INVESTIGATION OF CERTAIN TERNARY SYSTEMS CONTAINING THORIUM AND URANIUM
John Thomas Venard (M.S. Thesis—Tenn. Univ., Knoxville) Jan. 1968 89 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2015) CFSTI: HC $3.00/MF $0.65

Potential advantages of thermal-breeder fuels having a metallic thorium matrix with a dispersion of either (Th,U)C or (Th,U)N led to an investigation of the Th–U–C and Th–U–N ternary systems. This investigation was limited to the 1000°C isotherm at 50 atomic per cent carbon or nitrogen and below. Alloys in the Th–U–C system were made by arc-melting techniques while those in the Th–U–N system were prepared by powder metallurgical techniques. Equilibration times for cast alloys in the Th–U–C system were found to be 240 to 350 hours at 1000°C and greater than 1000 hours at 800 and 800°C. In the Th–U–N system the 1000°C equilibration time was found to be 80 to 100 hours. Lattice parameters across the UC–ThC pseudobinary showed a slight negative deviation from Vegard's law and excellent agreement with published data. Across the UN–ThN pseudobinary, lattice parameters obey Vegard's law. The most uranium-rich compounds in equilibrium with metallic thorium were found to be $(Th_{0.906}, U_{0.094})C_{0.712}$ and $(Th_{0.944}, U_{0.056})N_{0.889}$, respectively. A thermodynamic analysis was shown to be consistent with the experimental results and yielded an estimate of the 1000°C free energy of formation of ThN. This value was found to be minus 51,900 calories per gram-mole. Author (NSA)

N68-21094# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

EFFECTS OF IRRADIATION ON THE MECHANICAL PROPERTIES OF TWO VACUUM-MELTED HEATS OF HASTELLOY N

H. E. Mc Coy, Jr. Jan. 1968 43 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-2043) CFSTI: HC $3.00/MF $0.65

The mechanical behavior of two vacuum-melted heats of Hastelloy N was evaluated at 650 and 760°C. The material was subjected to several thermal-mechanical treatments and then irradiated at 650 and 760°C to a thermal dose of 2.3×10^{20} neutrons/cm^2. The results are compared with those for unirradiated specimens that were given a similar thermal treatment. The various thermal-mechanical treatments had some relatively small effects on the unirradiated tensile properties, but the creep properties were very similar. The primary effects of irradiation were reductions in the creep-rupture life and the rupture ductility in both creep and tensile tests. These observations are explained on the basis of helium production in the metal by the $^{10}B(n,\alpha)$ transmutation. Author

N68-21125# Bhabha Atomic Research Center, Bombay (India).

COMPATIBILITY STUDY OF LIQUID ALUMINIUM AND NICKEL

B. M. Pande and R. P. Agarwala 1967 10 p refs

(BARC-301) CFSTI: HC $3.00/MF $0.65

In response to previous work conducted on the bonding of Al–Ni in the solid phase, in which it was found that only the β and γ phases were present out of the four thermodynamically stable below the eutectic temperature, an experiment was carried out to investigate if ϵ and δ phases of Al–Ni systems are still suppressed in the liquid state. The preparations for conducting the experiment are delineated. An X-ray diffraction method was used to identify the different phases at the various temperatures and times. It seems that in the Al–Ni system the rate constant for γ-phase is very large because of high flow rates and small miscibility gap for this phase, and in fact becomes highly dominating so as to suppress the β-phase completely. The absence of δ and ϵ-phases implies that they have small flow rates and high miscibility gap compared to the γ-phase. B.S.D.

N68-21130# Denver Research Inst., Colo.

A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTHS AND RELATED METALS Final Report

Charles E. Lundin and Albert S. Yamamoto Sep. 1967 468 p refs

(Contract AT(11-1)-1298)

(DRI-2437) CFSTI: HC $3.00/MF $0.65

The alloying behavior of Nd–Pr, Gd–Y, Gd–Sm and Sm–Y systems was studied. The deviation from solution ideality, calculations of free energies, and enthalpies and entropies of mixing were used as criteria. Variables considered were atomic diameter, crystal structure, electronegativity, electronic structure, and valence. The Nd–Pr system is thermodynamically ideal and there are no variables introduced. Crystal structure is the variable introduced in the Gd–Sm system. Excess enthalpy and entropy cause strain in the alloys. The variable in the Gd–Y system is electronic structure but ideality of the complete solid solution exists. In the Sm–Y system, the variables were crystal and electronic structure. The thermodynamics are similar to those of the Gd–Sm system. The difference in electronic structure is negligible in the Gd–Y system whereas the crystal structure variable in the Gd–Sm system caused a large negative deviation from an ideal solution. Combining these two gives the conditions found in the Sm–Y system. NSA

N68-21142# Atomics International, Canoga Park, Calif.

COMPUTED STRESS: RELAXATION CURVES FOR HASTELLOY ALLOY N

A. W. Dalcher 1 Nov. 1967 35 p refs

(NAA-SR-MEMO-12590) CFSTI: HC $3.00/MF $0.65

Creep and stress-relaxation relations were used to provide, analytically, stress-relaxation curves for Hastelloy-N material at various temperatures. The calculated results were compared with test data, where available, and found to be in good agreement. The computed relaxation curves provide information useful for design and analysis at temperatures for which there is no experimental data. The computer program developed for this effort is applicable to other materials which follow the creep rate relation, $\epsilon = k\sigma^n$. Author (NSA)

N68-21153# Advisory Group for Aerospace Research and Development, Paris (France).

THE POTENTIAL USE OF MATHEMATICAL MODELS IN MATERIALS DATA PRESENTATION WITH PARTICULAR REFERENCE TO THE AGARD MATERIAL PROPERTIES HANDBOOKS

A. G. R. Thomson Oct. 1966 41 p refs Presented at the 23d AGARD Meeting, Paris, 4–12 Oct. 1966

(AGARD-510) CFSTI: HC $3.00/MF $0.65

Creep data in the AGARD material properties handbooks are reviewed and means are discussed of improving the scope and usefulness of the data. Ambiguities in the definitions of creep extension and other material properties and the need for consistency in the presentation of data are discussed. Advantages of using mathematical models for the correlation and presentation of various kinds of material properties data are considered. Author

N68-21167# California Univ., Livermore. Lawrence Radiation Lab.

EXAMINATION OF ROLLED ALPAX/Al–Al_2O_3 SINTERED MATERIALS. APPLICATION OF BRAZING TO COMPONENTS OF SINTERED Al–Al_2O_3 MATERIALS

J. Herenguel and Cl. Leymonie Oct. 1967 36 p refs Transl. into ENGLISH from Mem. Sci. Rev. Met., v. 61, 1968 p 43–54 Presented at the Autumn Met. Conf., Paris, 15–19 Oct. 1962

(UCRL-TRANS-10144; CONF-167-6) CFSTI: HC $3.00/MF $0.65

The construction of complex assemblies with the aid of Al–Al_2O_3 sintered materials poses the problem of the bonding of the components. Despite the improvements brought about in products by reducing the residual gas content, the welding of Al–Al_2O_3 sintered elements is a delicate operation. Brazing seems to offer worthwhile possibilities. Alpax was chosen as the brazing agent. Co-rolling was used to carry out studies on alpax-sintered Al–Al_2O_3 joints. Acceptable bonds were obtained as a result of co-rolling at 350 and 450°C. However, after annealing at 450, 500 and 560°C to simulate the temperature conditions to which the cladding is likely to be subjected in practice, a noticeable stripping of the Si particles in the alpax was observed in the diffusion zone. The same experiments were carried out again, the normal alpax being replaced by a grade to which 0.02% sodium has been added. Under these conditions the diffusion was no longer disturbed by the presence of coarse particles of Si and the diffusion zone is free of incipient internal fractures. Brazing pieces of sintered Al–Al_2O_3 seems feasible. Author (NSA)

N68-21195# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

HYDROGEN ACCUMULATION RATES WITHIN THICK-WALLED TUBES OF Fe–Cr AND Fe–Cr–Ni ALLOYS DURING EXPOSURE TO HIGH-PH, HIGH-TEMPERATURE, PRESSURIZED WATER CONTAINING DISSOLVED HYDROGEN

F. W. Pement Jun. 1967 41 p refs

(Contract AT(11-1)-GEN-14)

(WERL-1114-3) CFSTI: HC $3.00/MF $0.65

Hydrogen accumulation rates in evacuated bulbs of 347 stainless steel, Fe–Ni–Cr Alloy 600, and 410 stainless steel with or without platings of Ni or Cr were determined during extended exposures to hydrogen-bearing, pressurized, high-pH water at 575±5°F. Hydrogen accumulated least in the 347 stainless steel bulb and was almost eliminated by inclusion of a Zr–V getter. The 410 stainless steel bulbs accumulated the greatest quantities of hydrogen but the behavior was markedly influenced by the plating element. Tests to bond Zircaloy-2 to stainless steel were also conducted. Author (NSA)

N68-21205# Sandia Corp., Albuquerque, N. Mex.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ABOUT CONJUGATED FORMATION OF SEVERAL LAYERS IN DRY CORROSION
G. Valensi 14 Dec. 1967 27 p refs Transl. into ENGLISH from the French Paper Paper Given at the Intern. Conf., on Surface Reactions, Pittsburgh, 1948
(SC-T-67-0958)

It is possible to calculate global attack constant and composition of double layer, when a metal holding two oxides is corroded by oxygen. Results from practical equivalence between diffusional and electrochemical theories are verified in case of two layers. The same differential equations system is obtained, and it is shown how Price's method for establishing Wagner's equation can be generalized. If there is no coating at initial time, a simple process of integration is suggested, whose interest consists principally in its validity for solving the same problem when layers are more than two. It appears that under definite physical conditions, composition of product must remain constant. Experimental methods are described. The results obtained in copper oxidation studies are in good agreement with theoretical formulas. Abnormal results may be due to inadequate conditions and injurious influences of initial film from atmospheric corrosion and gases occluded in metal. Author (NSA)

N68-21208# Canada. Dept. of Mines and Tech. Surveys, Ottawa. Mines Branch.
STUDY OF AS-ROLLED CARBON STEELS OVER RANGES OF URANIUM, SULPHUR, AND CARBON CONTENTS
D. K. Faurschou Mar. 1966 54 p refs
(NP-17211; R-178) CFSTI: HC$3.00/MF$0.65

Test results indicate that uranium has a very limited potential usefulness as an alloying element in ferrous metallurgy. Uranium has more potential as a scavenger and sulfide former. A factorial set of as-rolled carbon steels having four uranium levels, three sulfur levels and two carbon levels was tested to assess the influence of uranium on impact characteristics, active-state corrosion resistance, stress-corrosion resistance, machinability, microstructure, and isothermal transformation of austenite. Author (NSA)

N68-21350# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy.
DISLOCATION-SOLUTE ATOM INTERACTIONS IN ALLOYS Progress Report, 1 Feb. 1967–31 Jan. 1968
R. Gibala, F. Povolo, M. G. Ulitchny, and K. V. Ravi [1968] 18 p refs
(Contract AT(11-1)-1676)
(COO-1676-1) CFSTI: HC$3.00/MF$0.65

Results of research on the dislocation-solute atom interactions in Fe–Ni alloys are summarized. It is established that substitutional solutes have only minor effects on the dislocation damping in bcc refractory metals, even after extended purification, compared with the residual interstitials. It was also determined that amplitude damping may be accurately described by a linear equation, Q_H is proportional to ϵ_0 that a linear dependence of damping on strain amplitude best characterizes the results obtained on Nb and some of its dilute substitutional alloys, and that temperature dependence of the amplitude damping shows the effect of at least two stages of pinning at 23 to 800°C. Effects of dislocation damping on zone-melted Nb and Nb-base alloys are diagrammed. NSA

N68-21363# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
SOME FRACTOGRAPHIC OBSERVATIONS OF FATIGUE CRACK GROWTH IN MARAGING STEEL
Carl M. Carman and Mary F. Schuler Nov. 1967 59 p refs
(FA-R-1871; AD-666187)

The fatigue crack propagation rates of 250 and 300 grade maraging steel were determined using two programming techniques: (1) cycling at a constant stress, and (2) cycling at a constant value of K. The rate of fatigue crack propagation was determined using macroscopic and electron fractographic methods, and the results were plotted as a function of cyclic K. Test results, using both methods, exhibited a fourth power relationship, as proposed by Paris. Both techniques, macroscopic and microscopic, yielded the same propagation rate. Previously, fractographic studies of maraging steels have not revealed the presence of fatigue striations. However, this investigation has shown the presence of fatigue striations, fatigue steps and slopes, slip band cracks associated with fatigue striations, tire tracks, ductile rupture dimples, and cleaved particles. The various features observed on the fatigue surface are discussed in terms of the mechanisms which are responsible for their formation. Author (TAB)

N68-21372# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy.
INTERSTITIAL ALLOYS OF BCC METALS
R. Gibala and C. A. Wert (Ill. Univ., Urbana) 31 Oct. 1967 140 p refs
(Contract AT(11-1)-1676)
(COO-1676-3) CFSTI: HC$3.00/MF$0.65

A description of the geometry of bcc interstitial alloys is given. A statement of the thermodynamics and experimental studies of the metal-gas systems is included. Internal friction and diffusion of the interstitials are discussed. Interstitial-interstitial and interstitial-dislocation interactions are developed. A listing of 186 references is included. NSA

N68-21431*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON MICROSCOPE TECHNIQUE SUGGESTED TO REVEAL MICROSTRUCTURES OF DISPERSION-STRENGTHENED MATERIALS
Bruno C. Buzek Washington Apr. 1968 9 p refs
(NASA-TM-X-1561) CFSTI: HC$3.00/MF$0.65 CSCL 13H

This report describes a preparation and replication method which has produced consistently good results for a number of materials. To show the effectiveness of the method evolved, measurements of volume percentages of dispersoids were compared with values obtained from chemical analysis. Typical microstructures of differently produced dispersion-strengthened materials are shown. The method that was found to be satisfactory uses conventional metallographic specimen preparation procedures up to the two final steps of polishing. For this final polishing, 3-micron and 1/2-micron diamond polishing compounds are necessary. This produces a flat and distortion-free surface. Etching of the samples should be extremely light. The etchants used depend on sample composition and history. The samples are then cleaned in an ultrasonic bath and further cleaned with plastic by dry stripping. Replication of samples with a conventional two-stage method of plastic–carbon and platinum shadowing follows. A good correlation was obtained between volume percent dispersoid measured on the resulting electron micrographs and the values obtained by chemical analysis. This replication procedure was found satisfactory for use with nickel, tungsten, chromium, cobalt, and their alloys. Author

N68-21432# Army Engineer Research and Development Labs., Fort Belvoir, Va.

CATASTROPHIC PITTING OF ALUMINUM-ALLOY (ALMAG 35) CASTINGS DURING SULFURIC ACID ANODIZING

Howard G. Lasser and Emerson Asher Jan. 1968 20 p refs
(Rept.-1919; AD-666217)

A problem concerned with the catastrophic pitting of aluminum-alloy (ALMAG 35) castings while being anodized is described. A method for overcoming this problem makes use of recognized preanodizing cleaning techniques. A proposed mechanism for the encountered corrosion is presented as an explanation to this problem. Author (TAB)

N68-21509# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.

STRESS-CORROSION CRACKING OF ALUMINUM ALLOYS—A REVIEW OF THE GERMAN LITERATURE

F. R. Mertens Aug. 1967 61 p refs
(Contract F33615-68-C-1325)
(DMIC-MEMO-23; AD-666083)

The phenomenon known as stress corrosion has been defined in several ways. For example, the definition which has been accepted in England is restricted to static stress: The term stress corrosion implies a greater deterioration in the mechanical properties of the material through the simultaneous action of the static stress and exposure to corrosive environment than would occur by the separate, but additive action of these surroundings. This definition includes stress-accelerated corrosion, but excludes corrosion fatigue. Author (TAB)

N68-21654*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MECHANISM AND KINETICS OF CORROSION OF SELECTED IRON AND COBALT ALLOYS IN REFLUXING MERCURY

Louis Rosenblum, Coulson Scheuermann, Charles A. Barrett, and Warren H. Lowdermilk Washington Apr. 1968 54 p refs
(NASA-TN-D-4450) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The cobalt-base HS-25 and H-8187 and the iron-base SICROMO-9M, AM-350, and AM-355 were corrosion tested in boiling mercury in the temperature range of 1000° to 1300°F for times as long as 5000 hours. Metallographic, chemical, and physical analyses were used to determine the extent and the nature of the corrosion. Corrosion mechanism and reaction kinetics were inferred through a comparison of experimental and theoretical kinetic constants. The experimental kinetic constants (i.e., the time-law constant b_i and the activation energy ΔH_i) were obtained from the test data by multiple regression analysis. The theoretical kinetic constants b_i and ΔH_i for each of i steps of proposed corrosion models were obtained from transport theory relations and the pertinent boundary conditions. Changes of mechanism during the progress of corrosion were indicated for all the alloys tested except the AM-350 and AM-355 alloys. The shifts from one corrosion regime to another were associated with changes in the nature and length of the corrosion-affected zone. Three corrosion regimes were characterized, linear I, parabolic, and linear II. The probable rate-determining step in the two linear rate regimes is boundary-layer diffusion. The probable rate-determining step in the parabolic rate regime is liquid diffusion. Author

N68-21718# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

INSTABILITY OF TITANIUM AND TITANIUM ALLOY Ti/6Al/4V

W. A. Wood Jan. 1968 25 p ref
(Contract Nonr-266(91))
(TR-54; AD-665975)

Previous tests showed that tubular specimens of alloy Ti/6Al/4V tested in torsion began to creep as a yield torque Y was reached. The present tests show that if a specimen after creep under torque +Y is loaded in the reverse direction it begins to creep under torques much less than -Y. The report records details of this reduced stability under reversed loading and of its temporary removal by stress-relieving heat treatment. The practical implication is that stability of service components are liable to depend on their stress history during fabrication. Author (TAB)

N68-21768*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CRACK GROWTH IN 2014-T6 ALUMINUM TENSILE AND TANK SPECIMENS CYCLICALLY LOADED AT CRYOGENIC TEMPERATURES

William S. Pierce Washington Apr. 1968 40 p refs
(NASA-TN-D-4541) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The cryogenic low-cycle fatigue crack growth behavior of 2014-T6 aluminum through-notched uniaxial tensile and biaxial pressure vessel specimens was studied. Low-cycle crack growth data were obtained from the notched specimens at −320° and −423°F. Initial notch lengths from 0.125 to 1.0 inch and initial R ratios R_i (minimum to maximum initial stress intensity factor, $K_{min,i}/K_{max,i}$) from 0.07 to 0.36 were studied. The parameters R_i and $K_{max,i}$ appear to be useful for relating crack growth rates in pressure vessels to those in tensile specimens. At −320° and −423°F the crack growth rates were almost equal for the pressure vessel and corresponding tensile specimen provided the R_i and $K_{max,i}$ values were held constant. The slopes of the curves for crack growth rate da/dN as a function of stress intensity factor range ΔK varied from 6 to 13 on a log–log plot. For a given ratio of maximum to critical stress intensity factor, the specimens tested at −423°F had longer lives than those tested at −320°F. Also, specimens run with higher R_i ratios had the longer cyclic lives for a given ratio of maximum to critical stress intensity. For similar values of R_i and $K_{max,i}$ the cyclic lives of tensile and tank specimens were almost equal, with the tensile specimens generally having longer lives. Author

N68-21784# Royal Aircraft Establishment, Farnborough (England).

THE CRYSTALLOGRAPHY AND DEFORMATION MODES OF HEXAGONAL CLOSE PACKED METALS

P. G. Partridge Mar. 1967 65 p refs
(RAE-TR-67058) CFSTI: HC$3.00/MF$0.65

The crystallography of h.c.p. metals is discussed in terms of the direct and reciprocal lattices. The axes used to define indices of directions and planes are described. Dislocations in hexagonal metals are listed and the conditions necessary for electron diffraction from hexagonal structures are established. The data required for the determination of dislocation Burgers vectors is tabulated. Finally the factors affecting the selection of a deformation mode and the rate controlling processes during slip are summarized. Author

N68-21841# Brown Univ., Providence, R. I. Metals Research Lab.

HYDROGEN IN ALPHA IRON DETERMINED VIA ULTRASONIC SNOEK EFFECT AND RELATED MEASUREMENTS Final Technical Report, 1 Jan.–31 Dec. 1967

Arthur E. Lord, Jr., Bruce B. Chick, and George P. Anderson Jan. 1968 71 p refs
(Contract N00019-67-C-0331)
(AD-665011) CFSTI: HC$3.00/MF$0.65

Snoek peak ultrasonic attenuation studies have given a lower limit for the relaxation strength of hydrogen atoms in solid solution in alpha-iron. The diffusion coefficient of hydrogen at 120K was also determined. A technique has been developed whereby

small changes in velocity (delta v/v = .00001) can be reliably followed for a few hours while charging a steel rod with hydrogen at 50C. The lack of a Snoek effect velocity change for our particular experiments, indicates that less than 0.60 ppm (by wgt.) of hydrogen is in solid solution. Our experimental results pertain to a 3/16-in. diam. 1018 steel rod sitting in a 4% H_2SO_4 bath (with CS_2 poison) at 50C, with no polarizing current, for two hours. This amount of hydrogen is well below that total amount (present in the specimen) needed to produce embrittlement.
Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-20839 Pennsylvania State Univ., University Park.
CHARACTERIZATION AND STRESS ANALYSES OF COMPOSITE VISCOELASTIC MATERIALS
Avva Vishnu Sharma (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-5963

A theory is proposed for the stress analysis of composite materials under steady temperature and varying external loading conditions. The material parameters of the composite medium, consisting of a copolymer of butadiene and acrylic acid cross-linked with Epon 828 as the viscoelastic matrix material and aluminum powder of 10 micron size as the elastic filler material, are predicted in terms of the known mechanical properties of the constituent materials. The material is shown to be a 'thermorheologically simple' solid. Compressibility and temperature effects on the mechanical behavior of the material are incorporated in the proposed theory. Using the stress–strain relations for the composite material, stress analyses for three problems, under different loading (mechanical and thermal) and boundary conditions, are performed. Theoretically predicted displacements were compared with experimentally observed values and found to be good, thus establishing the validity of the proposed theory for composite materials. Dissert. Abstr.

N68-20733# Alpha Research and Development, Inc., Blue Island, Ill.
INTERFACIAL INTERACTION IN COMPOSITE STRUCTURES Final Report, 20 Nov. 1966–19 Nov. 1967
William S. Layne and Robert L. Patrick 19 Nov. 1967 87 p refs
(Contract N00019-67-C-0460)
(AD-665697)

A program to examine the fundamental phenomena occurring at the interface of glass-resin composites is continued. The role of water at the interface is being studied by drawing E-glass rod from a melt in an anhydrous atmosphere and using it as a reference material with which to compare E-glass rods subjected to aging treatments with A-1100 silane, water and binder. Model glass-epoxide composites were constructed and examined gravimetrically and radiographically for diffusion of water through them. The influence of the variables mentioned above is also examined by modulus of rupture tests, scintillation counting, and exposure of radiographic emulsions following treatments with tritiated water. A-1100 treated E-glass, when made into a glass-epoxy composite, permits water transport along the interfacial zone. Pre-exposure of the glass to air, water vapor, liquid water, or binder did not permit transport of water in the interfacial zone. The modulus of rupture of E-glass rods decreased slightly with exposure to water or other liquids, but was unaffected by exposure to the atmosphere. Author (TAB)

N68-20734# Olin Mathieson Chemical Corp., New Haven, Conn. Chemical Group.
DEVELOPMENT OF SOLVENT-RESISTANT SEALANTS Final Report, 1 Feb. 1967–31 Jan. 1968
Maurice C. Raes, Nick S. Semenuk, and S. Venkataramaraj Urs 15 Feb. 1968 41 p refs
(Contract N00019-67-C-0339)
(AD-665683)

A flexible urethane lacquer sealant, applicable on aircraft surface as protection against corrosion was developed. It is based on a fluorinated polyether polyol, prepared by oxyalkylating a polyoxypropylenetriol with the glycidyl ether of 1,1,7-trihydro perfluoroheptanol. It contains 39% fluorine. The polyol is made into a prepolymer with tolylene diisocyanate and cured with 4,4-methylenebis- (o-chloroaniline). The coating on aluminum has good resistance to paint removers and high flexibility at -65F. Work was also initiated to prepare a fairing compound from the same type of urethane, with good adhesion, solvent resistance and flexibility. Author (TAB)

N68-20788 Rutgers Univ., New Brunswick, N. J.
DIRECT DETERMINATION OF POISSON'S RATIO OF SOME SIMPLE ALKALI-SILICATE GLASSES
William Brant Harsell (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5263

Values of Poisson's ratio of simple alkali silicate glasses are needed for studies of the elastic behavior of glasses. Little data is available for these values. The means to calculate them from data of other elastic constants is also virtually nonexistent, and, moreover, this method is not very satisfactory. A direct method of determining Poisson's ratio was considered necessary. From among the very few direct methods of obtaining Poisson's ratio, that of determining the relation of the radii of curvature from anticlastic bending of a flat beam was selected, using the interference of light to measure the defections. An improved method was developed to directly account for the significant effects of variation of the specimen surface from optical flatness; it has a reliability generally better than two and one half percent. It was observed that the effects of thermal history and small amounts of contamination of alkali silicate glasses greatly affect elastic properties. The value of 0.162 for Poisson's ratio of vitreous silica was confirmed.
Dissert. Abstr.

N68-20807# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
MODES OF FAILURE OF GLASS FIBER REINFORCED PLASTICS UNDER COMPRESSIVE LOADS Final Report
J. W. Gillman and H. T. Corten Sep. 1967 40 p refs
(Contract Nonr-3985(05))
(T&AM-307; AD-664688)

Parallel filament glass fiber reinforced plastics, having achieved notable success when used in members loaded primarily in tension, are being considered for high performance structures loaded primarily in compression. Previous work on compressive behavior both analytical and experimental, is reviewed. An experimental investigation is reported of the strengths and modes of failure of parallel filament ring segments loaded in compression parallel to the fibers in a special fixture designed to prevent gross buckling of the specimen. The observed modes of failure can be grouped into two categories: (1) failures that were initiated by local (microscopic) crippling (buckling) of individual filaments, and (2)

failures that were initiated by crippling of the ends of the specimen acting as a unit. Final failures frequently exhibited crumbling of the composite ends, longitudinal splitting, and crippling of groups of fibers adjacent to the grips which sometimes resulted in 45 deg. shear failures. Author (TAB)

N68-20828# New York Univ., N. Y. Research Div.
GASKETING MEDIA AT ULTRA-HIGH PRESSURE Final Report, 1 May 1966–30 Apr. 1967
Martin Prince and Yoshiyuki Okamoto Jun. 1967 30 p refs
(Contract AF 19(628)-5990)
(AFCRL-67-0592; AD-665860)

The development of new materials to be used as solid pressure transmitting media in ultra-high pressure, high temperature apparatus equipped with x-ray facilities has been investigated. The ultra-high pressure apparatus used was the tetrahedral anvil press. Four composite materials were found to be superior to all others tested: (1) 70% amorphous boron, 30% polyphenylene oxide; (2) 80% amorphous boron, 15% polyphenylene oxide, 5% Nalcon; (3) 80% lithium hydride, 20% polyphenylene oxide; and (4) 90% lithium hydride, 10% polyphenylene oxide. The composites were tested for their stability at high temperatures at atmospheric pressure under inert conditions and at a pressure of 40 kilobars in a tetrahedral anvil press. High pressure calibration experiments were performed for each composite by utilizing resistance transitions in bismuth I to II and II to III at room temperature. The materials have also been rated as effective gasketing materials by comparison to the standard material pyrophyllite. Other high temperature polymers such as polyimides did not prove satisfactory. Author (TAB)

N68-20874# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
CHEMICAL BOND INVESTIGATION OF NONSTOICHIOMETRIC GLASS PREPARED FROM GERMANIUM DIOXIDE, PART I
H. D. Kivlighn, Jr. Mar. 1968 48 p refs
(RM-409)

To gain insight into chemical bonding in the vitreous state, experimental observations have been correlated with concepts of comparative chemistry. The adaptation of carbon chemistry to the chemistry of germanium in the vitreous state has proved particularly successful with the identification of a (-Ge≡Ge-) linkage analogous to the (-C≡C-) bond. Discovery of a reproducible absorption peak at 2335 cm^{-1} during analysis of the infrared spectra of nonstoichiometric glasses prepared from germanium dioxide adds credence to this, as does the discovery that the intensity of the 2335 cm^{-1} absorption peak decreased as the glass was heat treated to the point where elemental germanium and hexagonal germanium dioxide precipitated from the previously amorphous substance. The observation that elemental germanium represented about 10 percent of the crystalline content of the crystallized glass suggests that multiple bonding in the vitreous state may also reach this level in at least one of the glasses tested. This would contribute to the disorder of the vitreous (GeO_4) tetrahedral distribution, adding positively to the vitreous entropy content. Author

N68-20898# Los Alamos Scientific Lab., N. Mex.
CMF-13 RESEARCH ON CARBON AND GRAPHITE Summary Progress Report, 1 May–1 Jul. 1967
Morton C. Smith 15 Sep. 1967 20 p
(Contract W-7405-ENG-36)
(LA-3758; Rept.-2) CFSTI: HC $3.00/MF $0.65

Research and development on carbons and graphites was undertaken to increase the understanding of their properties and behavior as engineering materials. The microstructures of natural, commercial, and experimental carbons and graphites were examined. The physical and mechanical properties of the materials were measured as functions of formulation, treatment, and environmental variables. Raw materials and manufacturing techniques were investigated, improved, and varied systematically to try to create specific internal structures believed to be responsible for desirable combinations of properties. NSA

N68-20961# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SYSTEMATIC PACKING FROM THE STANDPOINT OF THE PRIMITIVE CELL
Richard McGaw Dec. 1967 30 p refs Presented at the Northeastern Sect. of the Geol. Soc. of Am., Boston, 16 Mar. 1967 Submitted for publication
(CRREL-RR-201; AD-665372)

The systematic packing of uniform spheres is generalized by describing the primitive rhombohedral cell which characterizes the arrangement between layers. Volume and porosity are found to depend on only two angular parameters, alpha and beta: V = 8 R cubed sin alpha sin beta n = 1 - (pi/6 sin alpha sin beta). Beta is the angle between rows in a layer, and alpha is the altitude angle between members of adjacent layers. An azimuth angle gamma determines the position of the plane in which alpha is measured but does not enter into the porosity calculation. Four critical stacking arrangements are described, the porosities of which may be written as functions of the single parameter beta. The stable packings studied by Graton and Fraser (1935) are special cases of the critical positions. Typically unstable packings lie between these positions. Tables and graphs are presented which give the porosity of the primitive cell, as a function of alpha and beta, over the entire range from open to close packing for every possible layer configuration. Author (TAB)

N68-21086*# Stanford Research Inst., Menlo Park, Calif.
A STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTICS, PHASE 3 Summary Technical Report No. 3, 31 Mar. 1966–15 Jul. 1967
D. L. Chamberlain, Jr., M. V. Christensen, and M. D. Bertolucci 15 Aug. 1967 44 p refs
(Contract NASr-49(14); SRI Proj. PRU-4525)
(NASA-CR-93975; Rept.-13) CFSTI: HC $3.00/MF $0.65 CSCL 11D

The general objective of this research project was to evaluate the effect of deliberate and known bonding between glass and plastic on the physical properties of a composite material. During this report period, the effect on mechanical properties of direct chemical bonding between glass fibers and resin matrix was evaluated on experimental laminates of E-glass fabric (181 weave) and Epon 825 resin. Two laminates were prepared from alkylated glass fabric, two from fabric having the A1100 silane finish, and two from fabric without a finish. Mechanical test data show the flexural modulus of surface-modified samples to be at least equal to that for samples prepared with A1100 finish. Flexural strength, however, was somewhat lower than for the A1100 samples. Retention of strength after a two-hour boil was very good, approaching that of the well-known A1100 treatment. Retention of modulus after a two-hour boil was equal to that for A1100 samples. The results are discussed in relation to bonding mechanisms and degradation reactions at the glass–plastic interface. Author

N68-21183*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REVIEW OF ADVANCED COMPOSITE MATERIALS FOR SPACECRAFT APPLICATIONS
R. G. Moss 1 Nov. 1967 123 p refs
(Contract NAS7-100)
(NASA-CR-94040; JPL-TM-33-357) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Information was obtained from the literature, by attendance at meetings and symposia, discussions with workers in the field, and visits to some of the organizations active in composite development. Brief discussions of the theory of composite strengthening and reinforcement mechanics are presented.

Advantages, disadvantages, problem areas, and actual and potential applications are described. The status of testing, processing, forming, fabrication, and joining are noted. Many of the more important programs and organizations active in composite development are identified, as are anticipated advances in composite technology. Abstracts and comments on papers and reports on fibers and composites and a 162-title bibliography are included. Author

N68-21203# Dow Corning Corp., Midland, Mich. Aerospace Materials Dept.
SILICONES IN OUTER SPACE
J. A. Thorne and C. L. Whipple 1967 13 p refs Presented at the 11th Natl. Symp. of the Soc. of Aerospace Mater. and Process Engr., St. Louis, Apr. 1967
(Rept.-238)

Silicone elastometers, resins, and lubricants were evaluated for use in the high vacuum, temperature extremes, and radiation environments of space. Discussed are the effects of outgassing on physical and electrical properties, adhesive strength, and low temperature performance as well as such secondary effects as condensation of outgassing byproducts on optical and electrical surfaces. The effectiveness of techniques for removal of outgassing species is assessed. Methods for the collection and chemical analysis of volatile components are presented. Silicone diffusion pump fluids for creating hard vacuums are discussed, and the use of fluorosilicone lubricating fluids in mechanical pumps used with man-rated chambers and other vacuum systems where contact with gaseous oxygen may occur is considered. K.W.

N68-21252# Brown Univ., Providence, R. I. Engineering Div.
THE INFLUENCE OF SAMPLE PREPARATION ON THE SURFACE STRESS STATE AND PALMQVISTS METHOD FOR TOUGHNESS TESTING OF CEMENTED CARBIDES
H. E. Exner Jan. 1968 28 p refs
(Contract ARPA SD-86)
(ARPA-E55; AD-666555)

Different views exist on the influence of surface preparation on crack formation at Vickers indentations in the test used by Palmqvist to evaluate the toughness of cemented carbides. The present experimental results clearly show that grinding diminishes the thermal tensile stresses in the cobalt phase and thus reduces the crack length. The deformed surface layer is removed by polishing and a stress pattern is approached corresponding to that in the bulk material. Cracks of maximum length are characteristic of this stress state. Deformation stresses can be removed by annealing above 800C. On the basis of these results, sample preparation for the crack length test can be simplified, the accuracy of measurement is improved and a simple and significant parameter is found to describe crack resistance of cemented carbides. Author (TAB)

N68-21258# General Electric Co., Schenectady, N. Y. Research and Development Center.
THE FUTURE OF THE NEW CERAMICS
J. E. Burke and R. E. Carter Jun. 1967 10 p
(Rept.-67-C-234)

Over the past 20 years the field of ceramics has expanded greatly in fundamental understanding of the behavior of the materials, and particularly in the new ceramic substances that have found use in technology. We now find, for example, ceramic fuels at the heart of nuclear reactors, and ceramic magnetic ferrites as the memories in computers. Aluminum oxide ceramics are beginning to find use in important new high-efficiency lamps (at EXPO 67). In the next decade there is high probability that ionically conducting ceramics will become important in fuel cells and batteries. Author

N68-21308# Allen Clark Research Centre, Towcester (England).
A COMPARATIVE STUDY OF THE GASEOUS OXIDATION OF VITREOUS CARBON AND VARIOUS GRAPHITES AT 1500–3000°K
J. C. Lewis, I. J. Floyd, and F. C. Cowlard [1967] 31 p refs Prepared jointly with Beckwith Carbon Corp.

Weight loss rates of various oxidation-resistant carbons were measured in a tubular flow reactor in carbon dioxide, oxygen–argon and hydrogen–argon mixtures, and nitrogen. The effects of gas stream velocity up to 3500 cm/sec, of pressure up to 100 p.s.i. absolute, and of carbon surface temperature up to 3000°K, were investigated. Rate-temperature curves for reactions with CO_2 and O_2 exhibited a maximum and a minimum at temperatures which were markedly dependent on the type of carbon and only slightly dependent on pressure. Specific rates below about 0.05 g/cm^2 min were almost independent of gas stream velocity at the highest velocities used, but higher rates were probably limited by boundary layer diffusion. Initial results with a CO_2–Ar mixture at a fixed pre-heat temperature of about 2150°K showed that the reaction rate was appreciably greater than for "cold" gas; the general shape of the rate-temperature curve was similar, thus apparently eliminating the possibility that the rate maximum was due to a decrease in thermal accommodation efficiency with increase in temperature. It is suggested that the rate controlling step at temperatures near or above the rate minimum is the evaporation of carbon. Author

N68-21313# Army Materials and Mechanics Research Center, Watertown, Mass.
THE FINE MICROSTRUCTURE OF PYROLYTIC GRAPHITE AS INFLUENCED BY BORON
R. Nathan Katz and Charles P. Gazzara Jan. 1968 20 p refs
(AMMRC-TR-68-02; AD-666227)

A study of the fine microstructure of boronated pyrolytic graphite was made utilizing optical and X-ray diffraction techniques. The influence of boron content on the laminar structure, the lattice parameter, the lattice strain, the particle size, and the flexural strength of pyrolytic graphite were studied. Significant changes in the behavior of all investigated parameters were observed in the 0.50 to 0.75 percent boron range. A mechanism relating these changes to the appearance of B4C deposit is hypothesized. Author (TAB)

N68-21326# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
APPLICATION OF REACTION RATE ANALYSIS TO THE MECHANICAL PROPERTIES OF POLYMERS, 2
E. McAbee and D. W. Levi Feb. 1968 44 p refs
(PA-TR-3629; AD-665629)

Tensile strength data for nylon-6, polypropylene and polysulfone were analyzed according to a modified rate equation. The agreement of the test results with the theory was excellent. Author (TAB)

N68-21424# General Electric Co., New York. Research and Development Center.
AN EQUATION FOR THE YIELD STRESS OF A GLASSY POLYMER
R. E. Robertson Sep. 1967 7 p refs
(Rept.-67-C-353)

An equation is described for calculating the yield stress as a function of the temperature and the strain rate. The equation can contain as few as six parameters, none of which is adjustable. The only parameters needed for a specific polymer are the average volume of a chain segment containing two noncollinear bonds and the glass transition temperature. By comparing it with the experimental data from five different polymers, the caclulated yield stress is shown to be moderately reliable. Author

N68-21437# General Electric Co., New York. Research and Development Center.
ION EXCHANGE WITH A TWO-PHASE GLASS
R. H. Doremus Oct. 1967 3 p refs
(Rept.-67-C-404)

The exchange of silver between Pyrex glass and fused sodium–silver nitrates was studied. The exchange coefficient varied with silver concentration in the glass, in contrast to results on single-phase glasses such as fused silica and soda lime silicate. This variation with concentration is evidence that Pyrex glass has two phases; calculations from a simple model give exchange coefficients that are consistent with the expected compositions of these phases.
Author

N68-21490# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
EFFECT OF CURING TEMPERATURE ON THE THERMAL DEGRADATION OF AN EPOXIDE POLYMER
H. T. Lee Feb. 1968 46 p refs
(PA-TR-3624; AD-666212)

A conventional bisphenol-A epoxide was cured with m-phenylenediamine under five different curing temperatures. The thermal degradation of the cured and uncured resins took place at both constant temperature and constant heating rate. The thermal stability, based on the overall energy of activation and the order of reaction, was generally higher for the resin cured at a higher temperature. The highest curing temperature was 200C.
Author (TAB)

N68-21578# Mellon Inst., Pittsburgh, Pa.
THE RELATIONSHIP BETWEEN MOLECULAR STRUCTURE, MORPHOLOGY, AND THE MECHANICAL PROPERTIES OF POLYMERIC MATERIALS Final Technical Report, 1 Sep. 1958–31 Aug. 1967
Hershel Markovitz 31 Aug. 1967 26 p refs
(Contract Nonr-2693(00))
(MI-6099; AD-666123)

The report briefly summarizes the main results of research accomplished in the following categories: synthesis of model polymers, crystalline polymers, rheological studies and chain conformation of polymeric chains. The first category includes the synthesis of linear polystyrenes and poly-(methylstyrene) with narrow distribution of molecular weights, of well-characterized branched and comb polystyrenes. The section on crystalline polymers includes morphological studies by optical microscopy and light scattering, crystallization kinetics, crystallographic investigations and viscoelastic studies. Under rheological studies are included: a representation for the zero shear viscosity of a wide group of polymers as a function of molecular weight, temperature, and concentration; a corresponding states relation for the temperature dependence of the viscosity of a wide class of materials; the viscoelastic behavior of polystyrene; an analysis of the free vibration method in linear viscoelasticity; viscoelastic, crystal growth rate, and calorimetric studies on 1:3:5 tri-alpha-naphthyl benzene. The final section deals with the theoretical calculation of chain dimensions on the basis of a more realistic model. An appendix lists papers already published or in press.
TAB

N68-21589# Avco Corp., Lowell, Mass. Space Systems Div.
DIFFUSION STUDIES IN REFRACTORY MATERIALS Summary Report, 1 Mar. 1967–29 Feb. 1968
Feb. 1968 34 p refs
(Contract Nonr-4267(00))
(AVSSD-0029-68-RR; AD-665978)

Progress is described in a study of the effect of extrinsic influences on diffusion rates in ceramic oxides. The objectives of the program are to (1) determine the origin of enhanced grain boundary diffusion, (2) determine the effect, if any, of imposed stress on diffusion in single crystals, and (3) determine rates for specific impurity cations including some whose segregation and precipitation is known to influence transport and mechanical properties.
Author (TAB)

N68-21662*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF MOLTEN BINARY AND TERNARY OXIDE SYSTEMS Quarterly Status Report, 1 Dec. 1967–29 Feb. 1968
James F. Bacon, Robert B. Graf, and George K. Layden 1 Apr. 1968 68 p refs
(Contract NASw-1301)
(NASA-CR-94134; G910373-10; QSR-10) CFSTI: HC $3.00/MF $0.65 CSCL 11B

One hundred and fifteen additional glass making compositions were prepared, melted, and partially characterized making the total of original glass formulations studied under this program two hundred and sixty-five. New glasses prepared belong to one of five glass fields. Cordierite-rare earth compositions form the first glass system but in our recent studies emphasis has been placed on lowering the silica content, the liquidus temperature and the density while increasing the working range without sacrificing the 16 to 18 million psi modulus previously achieved in this system. The second glass field investigated is that of the calcium-aluminate glasses. The third glass system comprises the Morey-type optical glasses known to have the highest moduli of any known glass system. Invert glasses form the fourth region. The fifth area of glass composition research consisted of calcium aluminosilicate glasses lacking polarizable oxygen ions which have, therefore, high moduli where we have concentrated on substituting other high-field strength ions to note the effect achieved.
Author

N68-21674# General Electric Co., New York. Research and Development Center.
CYCLIC STRESS–STRAIN BEHAVIOR OF THE DRY POLYCARBONATE CRAZE
K. P. Kambour and R. W. Kopp Sep. 1967 32 p refs
(Rept.-67-C-374)

Equipment and methods have been developed that allow photomicrographic determination of the stress–strain properties of the individual craze. Serial cyclic tensile tests on polycarbonate crazes are described. Under stress the typical dry polycarbonate craze thickens solely by straining; no adjacent polymer of normal density is converted to craze material. The craze exhibits a yield stress followed by a recoverable flow to roughly 40% to 50% strain at 6000 to 8000 psi. Returned to zero stress, the craze exhibits creep recovery at a decelerating rate. The yield stress and loss factor of each cycle decrease with increasing initial strain, and cycles initiating at 50% strain or more show completely Hookean behavior. Creep recovery results in recovery of yield stress and loss factor also. Craze tensile behavior is suggested to be essentially an extension of the craze formation process. Decrease in elastic modulus and yield stress with increasing strain are rationalized in terms of strain-produced decrease in density and resultant increase in stress concentration factor on the microscopic polymer elements of the craze.
Author

N68-21764# Explosives Research and Development Establishment, Waltham Abbey (England).
AN EXAMINATION OF POSSIBLE DEGRADATION MECHANISMS IN THE CARBONISATION OF POLYACRYLONITRILE
B. J. Mac Nulty 17 Jun. 1966 16 p refs
(ERDE-9/M/66; WAC/174/010) CFSTI: HC $3.00/MF $0.65

Carbonization of polyacrylonitrile fibre gives rise to a material which can be successfully graphitized to a high strength fibre. The chemical reactions involved in the change from organic fibre to

carbon fibre are reviewed with the aim of deciding whether the process is unique and to what extent it may be controlled by the chemical nature and degradation mechanism of the original organic fibre. An experimental program to check the suggestions put forward is given. Author

N68-21840# Pennsylvania State Univ., University Park.
RESEARCH ON GRAPHITE Summary Report, Apr. 1, 1967–Mar. 31, 1968
P. L. Walker, Jr., H. B. Palmer, W. S. Diethorn, and D. E. Kline
20 Dec. 1967 83 p refs
(Contract AT(30-1)-1710)
(NYO-1710-71) CFSTI: HC $3.00/MF $0.65

The results of graphite research are summarized. The four main subjects investigated were carbon formation and graphitization, gas–graphite interaction and solid state studies, the mechanism of fission gas diffusion in graphite, and the dynamic mechanical properties of carbon and graphite. NSA

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-20579 California Univ., Berkeley.
ON A GROUP THEORETIC APPROACH TO LINEAR INTEGER PROGRAMMING
William Wallace White (Ph.D. Thesis) 1966 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-5190

An algorithm for solving integer programming problems is presented, and the relation of this work to cuts and appropriate geometric interpretations are given. The theoretical basis for the algorithm establishes a characterization of integer solutions to linear programs by considering the Gomory column group associated with the optimal linear programming basis. A particular class of cutting planes is discussed. These cuts are shown to be parallel to a subset of Gomory cuts and at least as strong as the Gomory cuts. Specially structured integer programs are discussed with a view toward speeding computation. Included in this discussion is a specialization to zero-one variables. Some computational results are given. It is seen that computational efficiency depends crucially on the size of the absolute value of the determinant of the optimal linear programming basis. In general, the smaller this absolute value, the more efficient the algorithm. Dissert. Abstr.

N68-20581 California Univ., Berkeley.
DECISION PROBLEMS FOR EQUATIONAL THEORIES OF SEMIGROUPS AND GENERAL ALGEBRAS
Peter Perkins (Ph.D. Thesis) 1966 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5140

A non-finitely based, six element semigroup of 2×2 real matrices under matrix multiplication is presented. It is shown that all commutative semigroups are finitely based, and bounds are given on the number of variables needed for a basis depending on certain parameters of the commutative semigroup. Furthermore, for each $n>1$ a commutative semigroup with $n+1$ elements is constructed which requires at least n variables in any basis for its identities. Dissert. Abstr.

N68-20587# Wisconsin Univ., Madison. Mathematics Research Center.
TOTALLY BOUNDED SETS OF PRECOMPACT LINEAR OPERATORS
Theodore W. Palmer Sep. 1967 13 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-789; AD-665343)

Totally bounded sets of precompact linear operators are characterized. Corollary: A collectively compact set Kappa is totally bounded iff Kappa* is collectively compact. Author (TAB)

N68-20609 California Univ., Riverside.
CONSEQUENCES OF THE JORDAN CURVE THEOREM
Lynn George Graf (Ph.D. Thesis) 1966 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5849

Let S be a nondegenerate, locally arcwise connected, metric space which is not separated by any arc or point and which satisfies the Jordan curve theorem. Let $|\gamma_\lambda|$ be the class of sequences, $\gamma_\lambda = |\gamma_{\lambda n}|$, of simple closed curves with associated complementary domains $I_{\lambda n}$. Let $[\gamma_\lambda]$ denote the equivalence class of $|\gamma_\lambda|$ containing γ_λ and define a base, B, for a topology on $|[\gamma_\lambda]|$ by $E \in B$ if and only if there exists a complementary domain I of a simple closed curve such that E contains all $[\gamma_\lambda]$. *Theorem.* $|[\gamma_\lambda]|$ with the topology given by B is homeomorphic to the 2-sphere. Also other results holding in the 2-sphere can be generalized to S. Dissert. Abstr.

N68-20613# Aberdeen Univ. (Scotland).
PROBLEMS IN PARTITION THEORY AND RELATED TOPICS Final Technical Report, 1 Aug. 1966–31 Oct. 1967
Edward M. Wright Nov. 1967 98 p refs
(Contract DAJA37-67-C-0020)
(AD-665400)

The report falls into six sections together with five appendices. The first investigation studies rotatable partitions. In the second section a general identity involving xi-functions is found. The third section introduces a new combinatorial idea, the n-stack, gives generating functions for the number of n-stacks under certain restrictions and under no restrictions and finds asymptotic values for these numbers for large n. The fourth appendix is a short, semi-expository paper correcting a statement by another author that a particular problem in partition theory is unsolved. The fifth section finds necessary and sufficient conditions that almost all graphs of a given kind on n unlabelled nodes shall be connected. The sixth section reports preliminary investigation into the asymptotic expansions of, and relations between, the number of connected and disconnected graphs of a given kind on n labelled and on n unlabelled nodes when n is large. TAB

N68-20614 California Univ., Berkeley.
WILD RAMIFICATION IN CYCLIC EXTENSIONS OF COMPLETE FIELDS
Bostwick Frampton Wyman (Ph.D. Thesis) 1966 44 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5194

Let k be a field complete at a discrete valuation with perfect residue class field $\bar{k}$ of characteristic $p\neq0$. If K/k is a Galois extension with group G and ramification sequence $|G_i|$, an integer b is called a *break number* for the extension K/k if $G_b \neq G_{b+1}$. If K/k is a cyclic totally ramified extension of degree p^n, $n\geq1$, then K/k has exactly n distinct break numbers, $b_1, b_2, \ldots, b_n$. The extent to which the later break numbers are determined by the first are studied. Dissert. Abstr.

N68-20615 Florida State Univ., Tallahassee.
SIMULTANEOUS NONLINEAR ESTIMATION
John Jones Beauchamp (Ph.D. Thesis) 1966 218 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-6460

Three nonlinear estimation procedures have been generalized so that they can be applied simultaneously to the problem of estimating the parameters present in a multiple equation regression model. The generalized estimation procedures have been designated by the following names: (1) generalized least squares (GLS) estimation procedure; (2) generalized partial totals estimation procedure; and (3) generalized Spearman estimation procedure. The three generalized estimation procedures have been applied to the estimation of the parameters for some of the members of the class of regression models which arise in the analysis of compartmental models. The GLS estimation procedure has also been applied to a more general class of multiple equation regression models than those mentioned in the preceding sentence. An extensive discussion of tracer experiments and various compartmental models has been included. Dissert. Abstr.

N68-20616 Purdue Univ., Lafayette, Ind.
CONDITIONAL PROBABILITY ON σ COMPLETE BOOLEAN ALGEBRAS
Ardeljohn Boes (Ph.D. Thesis) 1966 71 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5421

Probability as a measure on a Boolean algebra was presented by Kappos in his monograph "Strukturtheorie der Wahrscheinlichkeits-Felder und-Raume." A treatment of conditional expectation and conditional probability relative to a subalgebra is missing in this exposition. The present work is an attempt to supply such a treatment. This begins with a discussion of this problem through construction of the Stone space of the Boolean algebra. The existence of regular conditional probability measures with respect to a full subalgebra of Baire sets is shown not to require conditions on the original measure. The treatment of conditioning is possible without construction of the Stone space where the definition of probability on a Boolean algebra is modified. The existence of conditional probabilities is proved and some important properties are discussed. For this a generalized notion of integral is introduced and the theory of integration is begun for it. The relation between this probability and important special measure theoretic probability spaces is discussed. Dissert. Abstr.

N68-20621 New York Univ., N. Y.
ON SCHOTTKY GROUPS AND THE BOUNDARY OF SCHOTTKY SPACE
Vicki G. Chuckrow (Ph.D. Thesis) 1966 66 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6011

Every compact Riemann surface of genus g can be uniformized by a Schottky group, a discontinuous group of Mobius transformations mapping the Riemann sphere onto itself. The problem under consideration is the study of Riemann surfaces using Schottky groups. First some general theorems on Schottky groups are proven. Schottky groups are defined by actually specifying a standard set of generators. It is established that every set of free generators for such a group is a standard set of generators. It is also established that every subgroup of a Schottky group is a Schottky group. It is known that every Riemann surface can also be uniformized by a group of Schottky type. The two preceding results are extended to groups of Schottky type with appropriate modifications. Dissert. Abstr.

N68-20628 Illinois Univ., Urbana.
THE EXISTENCE AND GENERATION OF A HAMILTON CIRCUIT IN A TREE GRAPH
Takahiko Kamae (Ph.D. Thesis) 1966 42 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6642

The existence of a Hamilton circuit in a tree graph was first proved by R. L. Cummins in his Ph.D. thesis at the University of Illinois. However, the proof involves complicated procedures, and it is hard to apply it to the generation of all the trees in a given graph. The new proof, which is straightforward and concise, is given in this paper. This proof is constructive and applicable to the generation of all the trees in a given graph. A general procedure for obtaining a Hamilton circuit in a tree graph is shown. By applying this procedure, all the trees in a graph with 5 vertices and 8 edges are generated in an example. The procedure is of recursive nature and hence suitable for computation by a digital computer. Dissert. Abstr.

N68-20629 Maryland Univ., College Park.
ON THE CONVERSE TO THE CONTRACTION MAPPING PRINCIPLE
Philip Robert Meyers (Ph.D. Thesis) 1966 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6124

Let f be a self-mapping of a metric space (X,d). We find conditions under which f is a contraction i.e., f satisfies $d(f(x), f(y)) \leq \lambda d(x,y)$, $\lambda \epsilon (0,1)$, for every $x,y \epsilon X$. First this is done for selfmappings which are local contractions in the sense of Edelstein. This leads to the following converse to the contraction mapping principle. Let X be a metrizable space, and $f:X \rightarrow X$ a continuous map such that for some $\theta \epsilon X$, (i) $f(\theta)=\theta$; (ii) $f^n(x) \rightarrow \theta$ for all $x \epsilon X$; (iii) $f^n(U) \rightarrow \{\theta\}$ for some open neighborhood U of θ. Then for any prescribed metric d on X there is an equivalent metric $\bar{d}$, such that f is a contraction on $(X,\bar{d})$. This result is extended to semigroups of self-mappings and used to show an equivalence between contractive semigroups and asymptotic stability. Let θ be an equilibrium point with a compact neighborhood. The θ is asymptotically stable iff θ has a neighborhood $X_0 \subset X$, such that the restriction of $\{T_t : t \geq 0\}$ to X_0 is a contractive semigroup. Dissert. Abstr.

N68-20641 New York Univ., N. Y.
ASYMPTOTIC SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS IN THIN DOMAINS
Bernard J. Matkowsky (Ph.D. Thesis) 1966 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6041

Problems associated with the asymptotic solution of partial differential equations in thin domains are considered. By a thin domain, we mean one in which some of the dimensions are proportional to a small parameter ϵ. The asymptotic solution we consider is with respect to ϵ in the neighborhood of $\epsilon = 0$. In section II we extend the work of Fox and Westbrook who considered the asymptotic solution of potential problems in thin plates and shells of constant thickness. In section III we consider the asymptotic solution of the eigenvalue problem for the Laplace operator in thin two dimensional domains of variable thickness. In section IV we treat the eigenvalue problem for the Laplace operator in a two dimensional domain boundary by a closed convex curve. Dissert. Abstr.

N68-20642 New York Univ., N. Y.
REPRESENTATIONS OF CERTAIN ALGEBRAS
Horacio Alberto Porta (Ph.D. Thesis) 1966 53 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6049

Let $B(H)$ be the algebra of all bounded operators in a Hilbert space H, and consider the problem of determining the representations of $B(H)$ in another Hilbert space H. Jacob T. Schwartz has shown that every such representation splits in a canonical way into a direct sum of two subrepresentations of which one is either zero dimensional or faithful and the other annihilates all compact

operators, and also that, if H and H are separable, the second component must be zero dimensional. We show here that this is again the case when the representation is supposed to be highly continuous. The decomposition of representations established by Schwartz is shown to be a generalization of the decomposition of linear functionals on $B(H)$ obtained by Dixmier. Also studied are representations of the algebra of all holomorphic functions defined on some open (or compact) set X in an analytic complex manifold with values in $B(H)$. Dissert Abstr.

N68-20643 New York Univ., N. Y.
NUMERICAL ANALYSIS OF BOUNDARY LAYER PROBLEMS
William David Murphy (Ph.D. Thesis) 1966 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6044

We categorize some of the finite difference methods that can be used to treat the initial value problem for the boundary layer differential equation $\mu y' = f(y,x)$. We define a new kind of stability called μ-stability and prove that under certain conditions μ-stability implies convergence of the difference method. We investigate μ-stability and the optimal methods which it allows (i.e., methods of maximum accuracy). These results are generalized to the vector case. We also consider the related finite difference methods for the initial value problem $\mu y' = f(y,z,x)$ $z' = g(y,z,x)$. To illustrate the theoretical results, a number of problems were solved by these methods with the use of CDC6600 and IBM7094 computers. Dissert. Abstr.

N68-20649 Purdue Univ., Lafayette, Ind.
CHARACTERIZATIONS OF THE LATTICE OF ALL REAL-VALUED CONTINUOUS FUNCTIONS ON A COMPLETELY REGULAR SPACE
Geraldine Afton Jensen (Ph.D. Thesis) 1966 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5445

The purpose is to characterize C(X,R) as a lattice for X an arbitrary completely regular space. Two different characterizations are obtained. The first characterization is obtained by breaking the problem up into several steps. The second characterization uses a modification of the technique used for the compact case. It is essentially independent of the results and techniques of the first characterization. Dissert. Abstr.

N68-20655# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
STOCHASTIC PROGRAMS WITH RECOURSE: ON THE CONTINUITY OF THE OBJECTIVE
David W. Walkup and R. J.-B. Wets Jan. 1968 13 p refs
Its Math. Note No. 548
(D1-82-0704; AD-665736)

In an earlier paper, Stochastic Programs with Recourse, the authors introduced a general class of stochastic (linear) programs and showed, among other things, that the objective of any such program is convex when considered as a function of the first-stage decision variables. In this paper it is shown that the objective is also lower semi-continuous. In the process of proving this result, a lemma of general interest in the theory of convex functions is established. TAB

N68-20665 Illinois Univ., Urbana.
PROBABILITY AND A DIRICHLET PROBLEM FOR MULTIPLY SUPERHARMONIC FUNCTIONS
John Bradstreet Walsh (Ph.D. Thesis) 1966 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6765

This thesis applies probability methods to certain potential theoretical problems. Unlike the now-classical probabilistic potential theory, which is based on the theory of Markov processes, this thesis has for a cornerstone certain non-Markov processes. Some new measure theoretical results needed for our techniques are developed. Dissert. Abstr.

N68-20666 Auburn Univ., Ala.
MANIFOLDS IN A CONJUGATE SPACE
Bobby Earl Wilder (Ph.D. Thesis) 1966 45 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-4686

Four basic types of manifolds are defined, and various properties of these manifolds are studied in relation to properties of the space itself. Some characterizations of reflexiveness are obtained using properties of manifolds in the conjugate spaces. The notion of property D is introduced and sufficient conditions for a space to have this property are given, along with special examples. A relationship between property D and some known results is indicated in a chapter on applications. Dissert. Abstr.

N68-20667 North Carolina Univ., Chapel Hill.
PROPERTIES OF SEQUENTIAL TESTS WHEN THE CONDITIONS FOR STANDARD APPROXIMATE FORMULAE ARE NOT SATISFIED
David Gerhard Hoel (Ph.D. Thesis) 1966 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-5343

This dissertation is concerned with determining the properties of a sequential probability ratio test when the usual assumptions of independent and identically distributed log likelihood ratios (z_1, z_2, ...) are relaxed. A particular SPRT is given in which the observations are neither independent nor identically distributed. The properties of this test are obtained exactly and thus we are furnished with a model with which the various bounds, approximations and conjectures may be compared. Dissert. Abstr.

N68-20668 Florida State Univ., Tallahassee.
UNCONDITIONAL BASES IN LOCALLY CONVEX SPACES
Leon Jerome Weill (Ph.D. Thesis) 1966 51 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6486

Some fundamental theorems for unconditional bases are given in more general settings than Banach and Fréchet spaces. Included is a generalization of a theorem of L. A. Gurevic giving necessary and sufficient conditions for a sequence to be unconditionally basic; this theorem has some important applications in the paper. The main part of the paper is concerned with shrinking bases. Some applications to Reflexive spaces are also included. Dissert. Abstr.

N68-20673 Illinois Univ., Urbana.
THE THEORY OF QUASI-SASAKIAN STRUCTURES
David Ervin Blair (Ph.D. Thesis) 1966 67 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6561

On a contact manifold of dimension $2n+1$ there exists, by definition, a global 1-form η such that $\eta \wedge (d\eta)^n \neq 0$. Similarly an almost contact manifold also carries a fundamental 1-form η but it is not necessarily of maximal rank. The purpose of this thesis is to explore the meaning of the rank of η. We will work with an almost contact metric structure (ϕ, Ξ, η, g) where ϕ is a tensor field of type (1,1), Ξ the fundamental vector field and g the metric, these satisfying certain relations which determine the structure. We also require this structure to be normal and to have closed fundamental 2-form $\Phi(\Phi(X,Y) = g(X,\phi Y)$, X,Y vector fields); these enable us to obtain results in the desired direction as well as give

enough structure to obtain results having analogues in the theory of Kaehler manifolds. We call such a structure a quasi-Sasakian structure and if $\eta\nu(d\eta)^p \neq 0$ but $(d\eta)^{p+1} = 0$, we say the structure has rank $2p+1$ (it is proved that $(d\eta)^p \neq 0$ implies $\eta\nu(d\eta)^p \neq 0$ and hence that there are no quasi-Sasakian structures of even rank). Dissert. Abstr.

N68-20681 Illinois Univ., Urbana.
ON BOSE-CHAUDHURI-HOCQUENGHEM CODES OVER GF(q)
Vincent Yu-Sun Lum (Ph.D. Thesis) 1966 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6660

Two related aspects of the BCH codes have been investigated. The problems are (1) to have a better knowledge concerning their minimum distances, and (2) to find decoding methods not limited by the BCH bounds. A theory is presented which enables one to determine if a particular BCH code has minimum distance larger than its BCH bound. The derivation of this new theory is based on the Mattson–Solomon approach. The new results are easy to apply as illustrated by several examples. They are applicable to many codes including the well-known Golay (11,6) code over GF(3). A general algebraic full-power decoding method is outlined. In addition, two different methods are presented for the two special cases: the decoding of the two Golay perfect codes to its full error-correcting capability, and the decoding of concactonated codes. All decoding methods are found to be quite practical. Dissert. Abstr.

N68-20686 Purdue Univ., Lafayette, Ind.
ESTIMATION AND IDENTIFICATION OF NONLINEAR SAMPLED DATA SYSTEMS
William Burl Phillips (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5482

This research is concerned with the real time estimation of the state variables of nonlinear sampled-data systems. The state variables are assumed to be the output of a dynamic system which can be modeled by a nonlinear difference equation. The form of the difference equation and any deterministic inputs are assumed known within a vector of constant parameters. These constant parameters are adjoined to the original state vector to form the identification problem. To account for imperfect knowledge of the system, a vector of random disturbances is assumed to perturb the system's input. Measurements made on the system are assumed to be nonlinear combinations of the state variables corrupted by additive noise. The exact form of the nonlinear measurement is assumed known within a vector of constants and the measurements are made by sampling the system at a known, but not necessarily uniform rate. Dissert. Abstr.

N68-20687 Princeton Univ., N. J.
VARIATION OF STRUCTURE ON RIEMANN SURFACES
Richard Streit Hamilton (Ph.D. Thesis) 1966 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-5723

An analytic structure is constructed in the usual way on the set of equivalence classes of Riemann surfaces with homology bases, and the set of pairs of surfaces which admit an analytic map is studied. Dissert. Abstr.

N68-20692# Wisconsin Univ., Madison. Mathematics Research Center.
REMARKS ON STABILITY CONDITIONS FOR THE DIFFERENTIAL EQUATION X'' + A(T)F(X) = 0
James S. W. Wong Aug. 1967 13 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-809; AD-665339)

Two stability conditions are established for the non-linear differential equation x double prime + a(t) f(x) = 0, which extend the corresponding results for the linear equation. Author (TAB)

N68-20693# Purdue Univ., Lafayette, Ind. Div. of Mathematical Sciences.
MONOTONE CONVERGENCE OF BINOMIAL PROBABILITIES AND A GENERALIZATION OF RAMANUJAN'S EQUATION
Kumar Jogdeo (Courant Inst. of Mathematical Sci.) and S. M. Samuels Feb. 1968 13 p refs Supported in part by Ford Found.
/ts Mimeograph Ser. No. 141
(Contract Nonr-1100(26))
(AD-665779)

The paper contains two basic theorems which generalize results of Anderson and Samuels (1967) and Jogdeo (1967). These two theorems serve as lemmas for the more detailed results of Sections 3 and 4. Section 3 is devoted to a study of the median number of successes in Poisson trials (i.e. independent trials where the success probability may vary from trial to trial). The study utilizes a method first introduced by Tchebychev (1846), generalized by Hoeffding (1956) and used by Darroch (1964) and Samuels (1965). The results correspond to those for the modal number of successes obtained by Darroch (1964). Author (TAB)

N68-20694 Maryland Univ., College Park.
ASYMPTOTIC PROPERTIES OF SOLUTIONS USING THE SECOND DERIVATIVE OF A LIAPUNOV FUNCTION
James Alan Yorke (Ph.D. Thesis) 1966 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-6137

Let Ω be an open connected subset of R^n. We will consider the ordinary differential equation $dx/dt = F(x)$, where $F: \Omega \to R^n$ is a C^1 function; that is, all first partial derivatives of F exist and are continuous. We will let $\phi(\cdot, x)$ denote the solution of the equation such that $\phi(0,x) = x$. We assume in this abstract that in fact for all $x \in \Omega$, $\phi(t,x)$ is defined for all $t \in R$. Then ϕ is continuous on $R \times R^n$. *Definition.* Define: $\dot{V}(x) = \partial/\partial t\ V(\phi(t,x))|_{t=0}$ and $\ddot{V}(x) = \partial^2/\partial_t{}^2 V(\phi(tx))|_{t=0}$. Dissert. Abstr.

N68-20695 Columbia Univ., New York.
ON QUASI-LOGARITHMIC COEFFICIENT AND SOLUTION FIELDS FOR FIRST ORDER ALGEBRAIC DIFFERENTIAL EQUATIONS
Robert Kingman Wright (Ph.D. Thesis) 1966 188 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-5813

A differential field of functions is called p-constrained if every non-zero member is asymptotically equivalent as $z \to \infty$ to rational power products of z, log z,..., $\log_q z$, $q \leq p$. We study first order algebraic differential equations (a.d.e.'s) with coefficients in p-constrained fields. Strodt has shown that if a logarithmic monomial m is an approximate solution of the first order a.d.e. $Q(Y) = 0$ but not of $\partial Q/\partial DY)(Y) = 0$, if the coefficients are in a p-constrained field F, and if F is symmetric ($f(\overline{z}) \in F$ whenever $f(z) \in F$), then there is a solution y asymptotic to m. We show under precisely the above hypotheses, that at least one such solution may be chosen so as actually to lie in a q-constrained overfield of F, $q \geq p$; such a solution is called adjoinable. Our methods show that in general not every solution y asymptotic to m is adjoinable if there are many such solutions. Dissert. Abstr.

N68-20718# RAND Corp., Santa Monica, Calif.
ONE EQUATION TO RULE THEM ALL
Martin Davis Feb. 1968 18 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5494-PR; AD-665414)

The report describes an application of recursive function theory to Hilberts tenth problem. It is proved that if a particular exhibited diophantine equation has no nontrivial solutions, then all recursively enumerable sets are diophantine. Hence, if the exhibited diophantine equation has no nontrivial solutions, then Hilberts tenth problem is recursively unsolvable. The methods used can be

readily adapted to obtained various other hypotheses about which demonstrations can be made similar to the one given in this study. It has not yet been proved that the one equation to rule them all has no nontrivial solution, but so far the search for counterexamples has been fruitless. Author (TAB)

N68-20742# Wisconsin Univ., Madison. Mathematics Research Center.

COMPILER OF DIFFERENTIABLE EXPRESSIONS (CODEX) FOR THE CDC 3600

Allen Reiter and Julia H. Gray Dec. 1967 62 p
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-791; AD-665341)

In designing general programs for the solution of systems of nonlinear equations, for numerical integration, and for many other mathematical procedures one is confronted with the need for a generalized differentiation routine. CODEX is a program for the CDC 3600 designed to meet this need. The program reads the functions in from cards, translates them into code which is used in the differentiation and evaluation of the functions. Likewise the code resulting from differentiation of a function may be used in further differentiation and evaluation. Author (TAB)

N68-20764# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

DUALITY IN DISCRETE PROGRAMMING. 2: THE QUADRATIC CASE

Egon Balas Dec. 1967 14 p refs
(Contract Nonr-760(24))
(RR-116; AD-665318)

The paper extends the results of Duality in Discrete Programming (1) to the case of quadratic objective functions. The paper is, however, self-contained. A pair of symmetric dual quadratic programs is generalized by constraining some of the variables to belong to arbitrary sets of real numbers. Quadratic all-integer and mixed-integer programs are special cases of these problems. The resulting primal problem is shown, subject to a qualification, to have an optimal solution if and only if the dual has one, and in this case the values of their respective objective functions are equal. Most of the other results of (1) are also shown to carry over to the quadratic case. Author (TAB)

N68-20768# Purdue Univ., Lafayette, Ind. Div. of Mathematical Sciences.

THE TRANSIENT BEHAVIOR OF THE QUEUE WITH ALTERNATING PRIORITIES, WITH SPECIAL REFERENCE TO THE WAITING TIMES

Marcel F. Neuts and Micha Yadin (Kansas State Univ.) Jan. 1968 53 p refs *Its* Mimeograph Ser. No. 136
(Contract Nonr-1100(26); Grant NSF GP-7402)
(AD-665783)

A server operates two units with independent Poisson arrival processes and with independent, general servicetimes. He serves each unit until its queue becomes empty and then switches to the other unit of customers waiting there. If both units are empty, he operates the unit in which the first customer arrives and stays in it until it again becomes empty. This report discusses the time dependent and asymptotic distributions for the queuelength processes and for several virtual waitingtime processes. The analysis is in terms of imbedded semi-Markov processes. Author (TAB)

N68-20770# Aerospace Corp., El Segundo, Calif. Electronics Div.

OPTIMAL FILTERING FOR GAUSS-MARKOV NOISE, JULY-NOVEMBER 1967

A. R. Stubberud Dec. 1967 22 p refs
(Contract F04695-67-C-0158)
(TR-0158(3307-01)-10; SAMSO-TR-68-73; AD-665883)

The optimal continuous-filtering problem for the case of linear dynamics, linear measurements, and gaussian white disturbance and measurement noise has been solved by Kalman and Bucy. In this study, their results are generalized for the case where measurement noise is a Gauss-Markov process, but without augmenting state, as has already been done. Proof is presented that the optimal continuous-filtering problem can be solved by simply replacing the observation vector with a derived observation vector and an initial condition. When the derived observation vector is used, colored noise is eliminated and only the standard Kalman filter problem, easily solvable, remains. Author (TAB)

N68-20771# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

INVERSE THEOREMS ON THE BEST APPROXIMATION OF FUNCTIONS OF A COMPLEX VARIABLE

G. P. Safronova 11 Dec. 1967 12 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 13, [1966] p 40-46
(Contract NOW-62-0604-C)
(APL-TG-230-T539; AD-665594)

Results announced without proof by S. M. Lozinskii are transferred to the complex domain. The author considers functions continuous on D and analytic in D, where D is the interior of a Jordan curve formed by a finite number of smooth arcs with non-zero angles at the join points. The method of the proof differs only in insignificant details from that yielding the theorems of Lozinskii. Author (TAB)

N68-20786 North Carolina Univ., Chapel Hill.

ASYMPTOTICALLY EFFICIENT COMPETITORS TO THE MAXIMUM LIKELIHOOD ESTIMATORS

Jamie Joseph Goode (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-5338

In this thesis a method of constructing estimators is proposed. This method is perhaps most useful when the maximum likelihood estimator is difficult to compute. These estimators are shown to have asymptotic properties similar to those of the maximum likelihood estimators. In particular, they are asymptotically efficient. Asymptotic bounds on the distribution functions of these estimators are obtained. For the special case of estimating a location parameter a conjectured extension of a theorem on asymptotic bounds for distributions of sums of independent random vectors is used to find asymptotic bounds on the distributions of both the proposed estimators and the maximum likelihood estimators. Dissert. Abstr.

N68-20787 Illinois Univ., Urbana.

TOPICS IN THE THEORY OF LIE FIELDS

John Hood Lowenstein (Ph.D. Thesis) 1966 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-6659

Several aspects of the theory of Lie fields are discussed for which the commutator of the field operators at two space-time points is linear in the field, so that one has an infinite-dimensional Lie algebra. The existence of scalar Lie fields is not precluded by the algebraic considerations of inhomogeneous Lorentz invariance and weak locality alone. A vector Lie field associated with the coordinate transformations of differential geometry is discussed as the simplest example of a Lorentz-invariant, strictly local Lie field having a Lorentz-invariant vacuum representation. The possible usefulness of Lie fields are discussed in two contexts: (a) in the quantum-mechanical formulation of gauge invariance, and (b) in the description of nonrelativistic many-body systems (where, of course, the Lie fields are defined over Euclidean three-space). Dissert. Abstr.

N68-20804# George Washington Univ., Washington, D. C.
FIFTH ORDER PSEUDO–RUNGE–KUTTA METHODS
William Bromley Gruttke (Ph.D. Thesis) 5 Feb. 1968 84 p refs
Its Ser. T-200
(Contract N00014-67-A-0214)
(AD-665764)

Fifth order Pseudo-Runge-Kutta methods are derived for the numerical approximation of the solution of systems of ordinary differential equations. Convergence, consistency, and error bounds are also considered for these methods, and comparative results are given for these and other fifth order methods. The advantage of these methods lies mainly in the fact that for a fixed stepsize they require two less function evaluations at each step than do the corresponding fifth order Runge-Kutta methods, thus potentially saving a significant amount of computer time. The major disadvantage is that these methods are not self starting, while Runge-Kutta methods are. Author (TAB)

N68-20806# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE INFINITE DIFFERENTIABILITY OF THE FREE BOUNDARY IN A STEFAN PROBLEM
J. R. Cannon and C. D. Hill Aug. 1967 20 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF G-6052)
(MRC-TSR-806; AD-665349)

For a Stefan problem for the heat equation, estimates for the derivatives of the free boundary are obtained in the form of recursion relations which show that the free boundary belongs to a specific differentiability class. Author (TAB)

N68-20818# Wisconsin Univ., Madison. Mathematics Research Center.
AN ALGORITHM FOR POST-OPTIMALITY ANALYSIS OF STRUCTURED LINEAR PROGRAMS
K. Ritter and M. D. Grigoriadis Sep. 1967 16 p
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-815; AD-665338)

The paper describes an algorithm for performing post-optimal analysis - ranging and parametric programming - for large linear programs with a block diagonal structure. The method can be applied to problems which contain coupling constraints and/or coupling variables. Author (TAB)

N68-20819# Wisconsin Univ., Madison. Mathematics Research Center.
ADJOINT AND SELF-ADJOINT BOUNDARY VALUE PROBLEMS WITH INTERFACE CONDITIONS
Anton Zettl Nov. 1967 15 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-827; AD-665350)

In this paper the class of adjoint and in particular self-adjoint boundary value problems associated with ordinary linear differential equations is extended to include problems which may have discontinuities in the solution or some of its derivatives at a finite number of interior points. Author (TAB)

N68-20820# Wisconsin Univ., Madison. Mathematics Research Center.
ITERATED DEFERRED CORRECTIONS FOR INITIAL VALUE PROBLEMS
James W. Daniel, Victor Pereyra, and Larry L. Schumaker Aug. 1967 26 p refs
(Contract DA-124-ARO(D)-462)
(MRC-TSR-808; AD-665340)

A class of methods is presented for computing discrete solutions of successively higher asymptotic order for initial value problems for ordinary differential equations. Numerical experiments are discussed and an ALGOL program is appended. Author (TAB)

N68-20821# Wisconsin Univ., Madison. Mathematics Research Center.
A NOTE ON OBTAINING NATURAL SPLINE FUNCTIONS BY THE ABSTRACT APPROACH OF LAURENT
J. W. Jerome and L. L. Schumaker Aug. 1967 14 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-776; AD-665344)

The natural spline functions interpolating data on (a, b) are obtained constructively by the abstract variational approach of Laurent. The (as yet unpublished) theorem of Laurent is stated and applied in the present context to yield an algorithm for the calculation of the splines. The emphasis of the paper is to set the splines in the Hilbert space framework via the theorem of Laurent. Author (TAB)

N68-20822# Wisconsin Univ., Madison. Mathematics Research Center.
NONLINEAR FRACTIONAL PROGRAMMING
O. L. Mangasarian Dec. 1967 16 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-819; AD-665337)

The purpose of this note is to single out a class of nonlinear programming problems with linear constraints and an objective function (not necessarily convex) which is a ratio of two nonlinear functions, and to show how to solve these problems by solving a sequence of linear programs (the Frank-Wolfe algorithm). As an application, we show how to handle a class of bi-nonlinear objective functions (that is, functions which are the product of two nonlinear functions). Author (TAB)

N68-20896# Stanford Univ., Calif. Statistics Dept.
CONVERGENCE IN DISTRIBUTION OF STOCHASTIC INTEGRALS
Mark Brown 30 Jan. 1968 55 p refs
(Contract Nonr-225(80))
(TR-10; AD-665659)

A type of convergence of stochastic processes, convergence in linear law, is introduced. It entails convergence of finite dimensional distributions and a condition on the covariance kernels of the processes. A method is presented under which a sequence of finite collections of random variables, with suitable covariance structure, may be embedded in a sequence of continuous time processes satisfying the covariance conditions for linear law convergence. The paper illustrates that certain functionals of stochastic processes can be shown to converge in distribution to the corresponding functional of the limiting process, without an analysis of sample paths. Applications to limiting distributions of linear combinations of order statistics and linear combinations of successive differences of order statistics are presented. Limiting distributions are also obtained for certain random variables arising in nuclear chemistry and reliability. TAB

N68-20901 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE METHODS OF SOLUTION OF DIFFERENTIAL EQUATIONS
15 May 1967 230 p refs Transl. into ENGLISH of the publ. "Priblizhennyye Metody Resheniya Differentsial'nykh Uravneniy, AN UkrSSR, Institut Matematiki" Kiev, Izd. Akad. Nauk USSR, 1963 p 1–155
(FTD-MT-64-322; AD-663933)

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2. INFLUENCE OF HYSTERESIS MOTOR ON STABILITY OF MOTION OF GYROSCOPE IN CARDAN JOINT SUSPENSION R. M. Borodina p 11–19 refs (See N68-20903 11-23)

3. ON NUMERICAL SOLUTION OF THREE-DIMENSIONAL BOUNDARY VALUE PROBLEMS OF THEORY OF POTENTIAL BY METHOD OF SUM REPRESENTATIONS V. P. Gatun p 21–30 refs (See N68-20904 11-19)

4. CONCERNING THE QUESTION OF STABILITY OF MOTION IN ONE CASE OF THE THREE BODIES M. M. Zatenyakin p 31–37 refs (See N68-20905 11-23)

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6. ON THE INFLUENCE OF RANDOM FORCES ON NONLINEAR OSCILLATORY SYSTEMS V. G. Kolomiyets p 49–56 refs (See N68-20907 11-23)

7. SUFFICIENT CONDITIONS OF CONVERGENCE OF METHOD OF Yu. D. SOKOLOV DURING APPROXIMATE SOLUTION OF NONLINEAR INTEGRAL EQUATIONS OF TYPE OF HAMMERSTEIN N. S. Krupel' p 57–64 refs (See N68-20908 11-19)

8. ON THE CAUCHY PROBLEM FOR EQUATIONS OF HIGHER ORDER WITH MULTIPLE CHARACTERISTICS I. F. Kushnirchuk p 65–71 refs (See N68-20909 11-19)

9. ON RANDOM PROCESSES IN SIMPLE LINEAR DELAY SYSTEMS M. N. Maydanyuk and V. P. Rubanik p 73–77 refs (See N68-20910 11-19)

10. RANDOM SHOCKS IN LINEAR DYNAMIC SYSTEMS V. D. Mil'man and A. D. Myshkis p 79–100 refs (See N68-20911 11-23)

11. ON ADHERENCE OF SOLUTIONS OF A LINEAR UNIFORM SECOND ORDER DELAY DIFFERENTIAL EQUATION S. B. Norkin p 101–111 refs (See N68-20912 11-19)

12. SUBSTANTIATION OF PRINCIPLE OF AVERAGING FOR DIFFERENTIAL EQUATIONS WITH DISCONTINUOUS RIGHT SIDE A. M. Samoylenko p 113–120 refs (See N68-20913 11-19)

13. ASYMPTOTIC BEHAVIOR OF NEGATIVE PART OF SPECTRUM OF ONE-DIMENSIONAL DIFFERENTIAL OPERATORS B. Ya. Skachek p 121–137 refs (See N68-20914 11-19)

14. APPEARANCE OF THEORY OF POTENTIAL OF DOUBLE LAYER AND ITS FIRST APPLICATIONS TO SOLUTION OF CERTAIN BOUNDARY VALUE PROBLEMS V. S. Sologub p 139–161 refs (See N68-20915 11-19)

15. ON THE SOLUTION OF A TYPE OF NONLINEAR DIFFERENTIAL EQUATION E. F. Fayzibayev p 163–165 refs (See N68-20916 11-19)

16. ON THE EXISTENCE AND PROPERTIES OF INTEGRAL MANIFOLD FOR SYSTEM OF NONLINEAR DELAY DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS V. I. Fodchuk p 167–180 refs (See N68-20917 11-19)

17. ON NONLINEAR OSCILLATIONS OF A PLATE L. F. Shulezhko p 181–195 refs (See N68-20918 11-32)

N68-20904 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON NUMERICAL SOLUTION OF THREE-DIMENSIONAL BOUNDARY VALUE PROBLEMS OF THEORY OF POTENTIAL BY METHOD OF SUM REPRESENTATIONS [O CHISLENNOM RESHENII TREKHMERNYKH KRAYEVYKH ZADACH TEORII POTENTSIALA METODOM SUMMARNYKH PREDSTAVLENIY]

V. P. Gatun *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 21–30 refs (See N68-20901 11-19)

Proceeding from the formula of sum representations established for parallelepiped, consideration is given to the question about the numerical solution of the first three-dimensional boundary value problem of the theory of potential for a region composed of two parallelepipeds. Based on one auxiliary proposition which is analogous to the alternating method of Schwarz, it is shown that the system of linear algebraic equations corresponding to the given case for determination of the indicated parameters may be solved by the method of simple iteration. Author

N68-20906 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS OF ASYMPTOTIC SOLUTION OF ONE OPERATOR DIFFERENTIAL EQUATION [NEKOTORYYE VOPROSY ASIMPTOTICHESKOGO RESHENIYA ODNOGO OPERATORNOGO DIFFERENTSIAL'NOGO URAVNENIYA]

I. I. Kovtun' *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 39–47 refs (See N68-20901 11-19)

Consideration is given to the case in which A and B(t,ε) are operators acting in an infinite dimensional Hilbert space. A series of previously obtained results are generalized for this class of operators. Author

N68-20908 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUFFICIENT CONDITIONS OF CONVERGENCE OF METHOD OF YU.D. SOKOLOV DURING APPROXIMATE SOLUTION OF NONLINEAR INTEGRAL EQUATIONS OF TYPE OF HAMMERSTEIN [DOSTATOCHNYYE USLOVIYA SKHODIMOSTI METODA YU.D. SOKOLOVA PRI PRIBLIZHENNOM RESHENII NELINEYNYKH INTEGRAL'NYKH URAVNENIY TIPA CAMMERSHTEYNA]

N. S. Kurpel *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 57–64 refs (See N68-20901 11-19)

A generalized algorithm method is considered, and certain sufficient conditions of convergence of successive approximations and corresponding error estimates are given. The approach is based on the use of previously obtained data on applying the method of averaging functional corrections to approximate solutions of nonlinear integral equations, where certain sufficient conditions of convergence of successive approximations of error of n-th approximation are given. Author

N68-20909 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE CAUCHY PROBLEM FOR EQUATIONS OF HIGHER ORDER WITH MULTIPLE CHARACTERISTICS [O ZAUACHE KOSHI DLYA URAVNENIY VYSSHEGO PORYADKA S KRATNYMI KHARAKTERISTIKAMI]

I. F. Kushnirchuk *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 65–71 refs (See N68-20901 11-19)

The method of increasing the number of independent variables is extended to equations with multiple characteristics. Necessary and sufficient conditions are established for reducing the equation to the Bianchi equation, and solving the Cauchy problem. Author

N68-20910 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON RANDOM PROCESSES IN SIMPLE LINEAR DELAY SYSTEMS [O SLUCHAYNYKH PROTSESSAKH V PROSTYEYSHIKH LINEYNYKH SISTEMAKH S ZAPAZDYVAYUSHCHIM ARGUMENTOM]

M. N. Maydanyuk and V. P. Rubanik *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 73–77 refs (See N68-20901 11-19)

It is pointed out that in practical problems involving linear delay systems, initial conditions, system parameters, and initial data frequently have a random character. For solving these problems, a simple delay linear stochastic equation is formulated. It is assumed that the mathematical expectation and correlation function of the random initial function is known. The mathematical expection and correlation function of the random proces is found. Author

N68-20912 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ADHERENCE OF SOLUTIONS OF A LINEAR UNIFORM SECOND ORDER DELAY DIFFERENTIAL EQUATION [O SLIPANII RESHENIY LINEYNOGO ODNORODNOGO DIFFERENTSIAL'NOG URAVNENIYA VTOROGO PORYADKH S ZAPAZDYVAYUSHCHIM ARGUMENTOM]
S. B. Norkin *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 101–111 refs (See N68-20901 11-19)

Because of the linearity and homogeneity of the delay differential equation, only the case of adherence of trivial and nontrivial solutions is considered. Certain properties of the fundamental system of solutions are indicated. Intervals of adherence, corresponding to ordinary and special solutions of the equation, are compared. M.G.J.

N68-20913 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUBSTANTIATION OF PRINCIPLE OF AVERAGING FOR DIFFERENTIAL EQUATIONS WITH DISCONTINUOUS RIGHT SIDE [OBOSNOVANIYE PRINTSIPA USREDNENIYA DLYA DIFFERENTSIAL'NYKH URAVNENIY S RAZRYVNOY PRAVOY CHAST'YU]
A. M. Samoylenko *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 113–120 refs (See N68-20901 11-19)

The theorem of continuous dependence of solutions on the parameter is proved, and the principle of averaging for differential equations with a discontinuous right side is substantiated. Author

N68-20914 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC BEHAVIOR OF NEGATIVE PART OF SPECTRUM OF ONE-DIMENSIONAL DIFFERENTIAL OPERATORS [ASIMPTOTIKA OTRITSATEL'NOY CHASTI SPEKTRA ODNOMERNYKH DIFFERENTSIAL'NYKH OPERATOROY]
B. Ya. Skachek *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 121–137 refs (See N68-20901 11-19)

Consideration is given to the self-adjoint operator L, generated by the differential operation $l(y) = (-1)^n y^{2n} - q(x)y$ in L_2 (0, ∞) with any boundary conditions. It is assumed that q(x) is such that the negative part of the spectrum consists of an infinite set of values having unique limit point $\lambda = 0$. With the help of variational methods, the asymptotic behavior of negative values for any n is obtained. Author

N68-20915 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPEARANCE OF THEORY OF POTENTIAL OF DOUBLE LAYER AND ITS FIRST APPLICATIONS TO SOLUTION OF CERTAIN BOUNDARY VALUE PROBLEMS [VOZNIKNOVENIYE TEORII POTENTSIALA DVOYNOGO SLOYA I PERVYYE YEYE PRIMENENIYA K PESHENIYU NEKOTORYKH KRAYEVYKH ZADACH]
V. S. Sologub *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 139–161 refs (See N68-20901 11-19)

The appearance of potential of a double layer, and theorems of its properties are discussed. First applications of this idea to the solution of certain boundary value problems for the Laplace equation in the third quarter of the 19th century are clarified. Author

N68-20916 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Tech. Div.
ON THE SOLUTION OF A TYPE OF NONLINEAR DIFFERENTIAL EQUATION [O RESHENII ODNOGO TIPA NELINEYNOGO DIFFERENTSIAL'NOGO URAVNENIYA]
E. F. Fayzibayev *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 163–165 refs (See N68-20901 11-19)

An oscillatory system is mathematically described, and a series of four equations are derived for constructing the motion trajectory, if it exists. Author

N68-20917 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE EXISTENCE AND PROPERTIES OF INTEGRAL MANIFOLD FOR SYSTEM OF NONLINEAR DELAY DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS [O SUSHCHESTVOVANII I SVOYSTVAKH INTEGRAL'NOGO MNOGOOBRAZIYA DLYA SISTEMY NELINEYNYKH DIFFERENTSIAL'NYKH URAVNENIY S ZAPAZDYVAYUSHCHIM ARGUMENTOM I S PEREMENNYMI KOZFFITSIYENTAMI]
V. I. Fodchuk *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 167–180 refs (See N68-20901 11-19)

Theorems are given to prove the existence and stability of integral manifold for a system of nonlinear delay differential equations with variable coefficients. Author

N68-20933# Stanford Univ., Calif. Computer Science Dept.
RELAXATION METHODS FOR CONVEX PROBLEMS
Samuel Schechter 16 Feb. 1968 22 p refs
(Contracts Nonr-225(37); AT(30-1)-1480; Grant NSF GP-5962)
(CS-88; AD-665672)

Extensions and simplifications are made for convergence proofs of relaxation methods for nonlinear systems arising from the minimization of strictly convex functions. This work extends these methods to group relaxation, which includes an extrapolated form of Newtons method, for various orderings. A relatively simple proof is given for cyclic orderings, sometimes referred to as nonlinear overrelaxation, and for residual orderings where an error estimate is given. A less restrictive choice of relaxation parameter is obtained than that previously. Applications are indicated primarily to the solution of nonlinear elliptic boundary problems. Author (TAB)

N68-20953# Research Analysis Corp., McLean, Va. Advanced Research Dept.
A GENERAL REGULARIZED SEQUENTIAL UNCONSTRAINED MINIMIZATION TECHNIQUE
Anthony V. Fiacco Feb. 1968 17 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-296; AD-665300)

A general interior sequential unconstrained methodology is extended by a regularization of the auxiliary function. The principal results are the elimination of the interiority and closure restrictions previously imposed on the feasible region. Local convergence is proved for the nonconvex problem under very general conditions. Author (TAB)

N68-20960# Hebrew Univ., Jerusalem (Israel). Dept. of Mathematics.
QUASI-HOMOGENEOUS UTILITIES
Bezalel Peleg Dec. 1967 8 p ref
(Contract F61052-67-C-0094)
(RM-33; AD-665468)

It is proven that a homogeneous and archimedean preference relation on a cone can be represented by a quasi-homogeneous utility. Author (TAB)

N68-21060 Illinois Univ., Urbana.
HYPERARITHMETICAL FUNCTIONS OF ORDINAL NUMBERS
John Penn Mayberry (Ph.D. Thesis) 1966 58 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6674

Definitions of hyperarithmetical and analytic predicates and functions of ordinal numbers are given, analogs of the enumeration and hierarchy theorems for analytic predicates of natural numbers are given, and the predicate is shown to be expressible in both of the one function quantifier forms in the hierarchy of analytic predicates of ordinal numbers. In a system of class-set theory satisfying the second order reflection principal: there is an arithmetrical well-ordering whose order type is greater than that of any recursive well-ordering, and there is a hyperarithmetical well-ordering whose order type is greater than that of any arithmetrical well-ordering. Finally, the following theorem is established by analysing the computation of hyperarithmetical functions; there is a predicate, expressible in both of the one function quantifier forms of the analytic hierarchy, which is not hyperarithmetical. Dissert. Abstr.

N68-21061 Maryland Univ., College Park.
APPLICATIONS OF THE TRANSFINITE DIAMETER TO THE THEORY OF CONFORMAL MAPPING
Melvyn Klein (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-6278

Let f(z) be a function in S_S and: $\eta_1, \eta_2, \ldots \eta_n$ a set of n-th roots of unity. An inequality for the transfinite diameter of n compact sets is proved, generalizing the following result of Renngli: If T_1 and T_2 are compact sets in the plane then: $d(T_1 \cap T_2) \cdot d(T_1 \cup T_2) \leq d(T_1) \cdot d(T_2)$. Dissert. Abstr.

N68-21065 Ohio State Univ., Columbus.
NEAR ALGEBRAS
Harold David Brown (Ph.D. Thesis) 1966 69 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6299

The notions of an ideal, a right ideal, a left ideal and a near algebra homomorphism are defined, and some consequences of these definitions are derived. The structure of the multiplicative semigroup of a near algebra N is investigated and some conditions under which a multiplicative ideal of N is closed under addition are determined. In analogy to Lie algebra theory, the notions of d-solvability and d-semisimplicity are defined, and some consequences of these definitions are derived. Semi-simple near algebras are investigated and, as for near rings, it is proved that a semi-simple near algebra can be decomposed into a ring theoretic direct sum of simple near algebras. Near algebras over R or C which admit a topological structure are investigated, and the main result—any semi-simple near algebra over R or C which is also a Banach space with respect to some norm function and for which right multiplication is differentiable at the origin is a semi-simple algebra—is proved. Dissert. Abstr.

N68-21100*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTI-STEP RUNGE–KUTTA METHODS
Joseph S. Rosen Washington Apr. 1968 23 p refs
(NASA-TN-D-4400) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The multi-step methods presented in this report differ from the classic, single-step Runge–Kutta process by utilizing the numerical results of the previous integrations. As developed here, the multi-step process avoids the complex Taylor expansions of the functions involved and instead employs the writer's previously developed method of quadratures. Author

N68-21107 Princeton Univ., N. J.
A CONJUGATE GRADIENT METHOD FOR NONLINEAR PROGRAMMING
Donald Goldfarb (Ph.D. Thesis) 1966 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-5719

A new method for solving nonlinear programming problems in which the constraints appear linearly is described. Starting from an initial feasible point the technique locates new feasible points with ever increasing values of the objective function. At each iteration the algorithm attempts to move in a direction which is conjugate to the previous directions of search. This is accomplished by operating on the gradient direction with a non-Euclidean projection matrix, H_q which also acts as a variable metric for each maximization problem. The conjugate gradient method may, therefore, be looked upon as an extension of the work of Davidon and of Fletcher and Powell to problems involving linear inequality constraints. Necessary and sufficient conditions for a global maximum are derived for the case of a concave objective function, and it is proved that the method always converges for this case. Dissert. Abstr.

N68-21108 North Carolina State Univ., Raleigh.
GENERALIZED PERMANENTS AND HAFNIANS
Peter Murray Gibson (Ph.D. Thesis) 1966 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5677

It is shown that many of the properties of the permanent of a square matrix carry over to the rectangular case. Applications are given of permanents of rectangular matrices. It is shown that the number of matchings of bipartite graphs can be determined by using permanents of rectangular matrices. A number of inequalities and equalities are developed for permanents of special types of square matrices with emphasis on substochastic matrices. A theory of hafnians is developed. Relationships between the hafnian and the permanent are demonstrated. Applications of the hafnian are given, *e.g.*, it is shown that the hafnian can be used to determine the number of matchings of graphs. Dissert Abstr.

N68-21110 Pennsylvania State Univ., University Park.
EXTENSIONS OF SEMIGROUPS
Hugo Trigo D'Alarcao (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-5908

Let A and B be semigroups. If S is a semigroup which contains A as a subsemigroup and such that there is a homomorphism f of S upon B with the property that the inverse image under f of the idempotents of B is isomorphic to A, then, S is said to be an idempotent extension of A by B. If moreover, f separates the idempotents of S, i.e., if f(e) = f(i) for e and i two idempotents of S then, e = i; then S is called an idempotent-separating extension of A by B. It is shown that any idempotent extension of a group A by a group B is a homogroup. In the case of inverse semigroups, idempotent-separating extensions are characterized in terms of pairs of elements and three suitable mappings. Idempotent-separating extensions of a regular semigroup whose idempotents form a subsemigroup by a regular semigroup are also considered. Dissert. Abstr.

N68-21192*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
REPRESENTATIONS FOR SOLUTIONS OF LINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS
H. T. Banks Mar. 1968 20 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67)
(NASA-CR-93953; TR-68-2) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This paper points out a mistake in Halanay's linear differential systems with time delays, and presents the correct results. The systems appear as the linear variational equations in the study of

general nonlinear variational (optimal control) problems. The error is due to an incorrect interchange of the order of integration involving a Stieltjes integral. If The Stieltjes integral can be written as a sum plus a Lebesgue integral, then the ordinary Fubini theorem can be used. However, in the general case where the measure depends on both variables of integration and contains a singular part, an unsymmetric Fubini type theorem must be used. To use this correctly, one must always interchange over regions which are rectangles. Halanay's system (1) includes as a special case a system with a simple time lag (2). If the adjoint system given by Halanay for the general case of (1) is correct, it should reduce to the adjoint system for (2) whenever (2) is considered as a special case of (1). It is shown that it does not and hence must be incorrect. R.N.A.

N68-21209# Oak Ridge National Lab., Tenn. Mathematics Div.
INFORMATION THEORY IN SEQUENTIAL ANALYSIS
Roger Lee Tittle (Ph.D. Thesis—Tenn. Univ., Knoxville) Jan. 1968 53 p refs
(Contract W-7405-ENG-26)
(ORNL-4208) CFSTI: HC $3.00/MF $0.65

The information as defined in a sequential test S of simple hypotheses, which is determined by cumulative sums of independent and identically distributed random variables and which terminates with probability 1, is investigated. The Wald sequential probability ratio test is given particular emphasis as a special case of the general test S. In the case of a sequential probability ratio test, it is demonstrated that information $I(a) = I(c)$ whenever the sequential probability ratio test of hypotheses $g_i(u)$, $i = 1, 2$, belong to an important class of density functions, namely the exponential family. All of the primary results stated previously are obtained for the case in which all the random variables under consideration admit a Borel measurable density function; however, by interpreting integrals as sums, and replacing Lebesque measure by the counting measure, the results remain valid for the discrete case as well. Author (NSA)

N68-21271# California Univ., Livermore. Lawrence Radiation Lab.
METHOD OF NUMERICAL INTEGRATION OF THE DIFFUSION EQUATION
V. K. Saul'ev Mar. 1967 7 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 115, no. 6, 1957 p 1077–1079
(UCRL-TRANS-10190) CFSTI: HC $3.00/MF $0.65

The diffusion equation is stated along with its initial and boundary conditions. A simple and stable (in the sense that no errors are accumulated) method of solving the problem is introduced. The method is written in the form of functional equations. The method has a practical advantage in cases where the predominant requirement is stability and not convergence. It can also be applied to more general parabolic equations and systems. R.N.A.

N68-21306# RAND Corp., Santa Monica, Calif.
A NOTE ON "INSTANT INSANITY"
T. A. Brown Feb. 1968 10 p
(P-3689; AD-665834)

Analysis of a puzzle called "Instant Insanity", which is made up of multicolored unit cubes, is considered in terms of means for effecting quick solutions as well as for the design of other puzzles that might be easier, harder, or actually impossible. It is shown that there are only two essentially different solutions to the particular puzzle being studied; and these methods are considered applicable to the solution of three other puzzles that are presented in increasing order of difficulty. M.W.R.

N68-21312# Ohio State Univ. Research Foundation, Columbus.
SUCCESSIVE APPROXIMATION OF SOLUTIONS OF MOLODENSKY'S BASIC INTEGRAL EQUATION
Karl-Rudolf Kock Aug. 1967 42 p refs
(Contract AF 19(628)-5701)
(Rept.-85; SR-14; AFCRL-67-0506; AD-666431)

The report is concerned with the successive approximation of the solutions of linear integral equations by electronic computers. An application is given by the approximation of Molodenskys basic integral equation. By a mathematical model Molodenskys solution of the basic integral equation is compared with the successive approximation of this integral equation. It is shown that the successive approximation is preferable. Author (TAB)

N68-21375# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ERROR BOUNDS FOR QUASI-HARMONIC OSCILLATIONS: NON-RESONANT CASE
Robert J. McLaughlin Aug. 1967 46 p refs
(Contracts Nonr-1866(16); Nonr-1866(07); Nonr-1866(32))
(TR-538; AD-666306)

The report describes a functional equation method for estimating the convergence interval and truncation error for periodic series solutions when the differential equation is a scalar, quasiharmonic equation of the non-resonant type. The method is due originally to A. M. Lyapunov, has been recently discussed in the Soviet Union by Yu. A. Ryabov particularly in connection with the convergence interval problem, and was described in a previous report in application to vector quasilinear equations. Here for the scalar, quasiharmonic, non-resonant case, the report gives a concise derivation, construction procedure, and solution method for a pair of functional algebraic equations whose solution majorizes the error in the differential equation truncated solution for parameter values within the convergence interval. The parameter value for which the functional equations first cease to have a solution provides an estimate of the convergence interval, and can be calculated explicitly. The report concludes by calculating the errors in zero-order and first-order solutions of the forced Duffing equation (non-resonant case). Author (TAB)

N68-21388# Sandia Corp., Albuquerque, N. Mex.
POISSON APPROXIMATION TO THE BINOMIAL AS A RELATION BETWEEN THE PERCENT POINTS OF THE BETA AND GAMMA DISTRIBUTIONS
George P. Steck Nov. 1967 14 p refs
(Contract AT(29-1)-789)
(SC-RR-67-886) CFSTI: HC $3.00/MF $0.65

Let X be a binomial random variable with parameters n and p, let Y be a Poisson random variable with parameter θ, and let the quantities n, p, θ, and k be so related that $P(X>k) = P(Y>k)$. The first few terms of the following series are derived: $n = \theta/w + k/2 + kw/24\theta\,(k + \theta + 2) + w^3C(k,\theta) + \ldots$ $n = \theta/w + k/w \log \alpha/w + D_1(k,w)/\theta + D_2(k,w)/\theta^2 + \ldots$ $\theta = wA - w^2 A(N-A)/k + 2 + w^3E(n,k) + \ldots$ $\theta = nw - k \log \alpha/w + F_1(k,w)/n + F_2(k,w)/n^2 + \ldots$ $w = \theta/N + k\theta/24\,(k + \theta + 2) + G(k,\theta)/N^5 + \ldots$ $w = \theta/A + (N-A/k + 2)\,(\theta/A)^2 + \theta^3H(n,k) + \ldots$, where $N = n - k/2$, $w = -\log_e (1-p)$ $\alpha = p/(1-p)$, A^{k+1} $n(n-1)\ldots(n-k)$. In the course of the derivations it is shown that $nw - k \leq \theta \leq nw - k \log \alpha/w$. Furthermore, extensive calculations suggest that $wA - w^2A/k + 2(N - A) \leq \theta \leq wA$. Author (NSA)

N68-21396# Wisconsin Univ., Madison. Mathematics Research Center.
SPLINES, N-WIDTHS AND OPTIMAL APPROXIMATIONS Summary Report
Michael Golomb Sep. 1967 25 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-784; AD-666196)

The Kolmogorov concept of n-width of classes of functions which is based on optimal approximating n-dimensional subspaces is modified to include optimal n-flats. As a special case, splines

appear as optimal 0-flats. Applications include the H superscript m-extension problem for functions of a real variable. Author (TAB)

N68-21400*# Brown Univ., Providence, R. I. Applied Mathematics Div.

A NOTE ON VOLTERRA INTEGRAL EQUATIONS AND TOPOLOGICAL DYNAMICS

Richard K. Miller and George R. Sell (Minnesota Univ., Minneapolis) [1967] 8 p refs Prepared with Minnesota Univ., Minneapolis

(Contracts NAS8-11264; DA-31-124-ARO(D)-265; Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GP-7041X)

(NASA-CR-94107) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Methods of Sell that permit the application of the theory of topological dynamics to a very general class of nonautonomous ordinary differential equations are extended to certain nonlinear integral Volterra equations. Because of the generality of the methods presented, they can be applied to many problems and an application is illustrated. Construction of the semi-flow or mapping is discussed, and admissible and compatible topologies are given along with compact motions and limiting equations. M.W.R.

N68-21403# Wisconsin Univ., Madison. Mathematics Research Center.

ON THE APPROXIMATE SOLUTION OF LINEAR EQUATIONS

M. B. Gagua Jul. 1967 32 p refs Transl. into ENGLISH from Tr. Vycisl. Centra Akad. Nauk Gruzin. (SSSR) vol. 3, 1963 p 27–47

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-759; AD-666197)

The problem of approximation of the solution of a linear equation Lx = y in an infinite-dimensional space by the solution of a finite-dimensional equation Ln x sub n - y sub n is considered in detail. Author (TAB)

N68-21456# Padua Univ. (Italy).

CURRENT ALGEBRA SUM RULES AND ASYMPTOTIC BEHAVIOUR

G. Sartori and M. Tonin [1967] 16 p refs

(PADOVAU-LA-1)

A new method is proposed to derive covariant sum rules from current algebra. This method is used in discussing the convergence properties of the sum rules and the limiting procedure required to obtain them. Author (NSA)

N68-21460# Stanford Univ., Calif. Dept. of Electrical Engineering.

ALGEBRA AUTOMATA 2: THE CATEGORICAL FRAME WORK FOR DYNAMIC ANALYSIS

Y. Give'on and M. A. Arbib [1967] 40 p refs

(Contract AF 49(638)-1440; Grant AF-AFOSR-1198-67)

(AFOSR-68-0454; AD-666457)

The treatment of algebra automata is extended to automata employing algebras over arbitrary theories. To this end Eilenberg and Wrights approach to the notion of a theory and its algebras originated by Lawvere are represented. Special attention is given here to the free theories which correspond, in ordinary automata theory, to the free monoids. For example, the free theories (like the free monoids) are characterized as the projective objects in the category of theories with surjective morphisms of theories only. For a theory T, a T-automation is defined in a straightforward analogy with the notion of an automation with an arbitrary input monoid. Our definition of a T-automation becomes obvious once it is recognized that a T-algebra is the appropriate explication for a right-action of T on a set. Consequently, the construction of a minimal realization and of a minimal dynamics of any given response function f on a theory is analogous to the same construction with respect to a mapping f on a monoid. Also the basic division lemmata which underlie Krohn and Rhodes composition theory of machines are true for response function on free theories. Author (TAB)

N68-21466# Wisconsin Univ., Madison. Mathematics Research Center.

PIVOT SIZE IN GAUSSIAN ELIMINATION WITH COMPLETE PIVOTING

C. W. Cryer Oct. 1967 43 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-729; AD-666195)

Let A = (a sub ij) be a real n x n matrix such that the absolute value of (a sub ij) = or < 1. It has been conjectured by Wilkinson that if the process of Gaussian elimination with complete pivoting is applied to A then all the pivots are less than or equal to n in absolute value. This conjecture is proved for n = 3 and n = 4. Author (TAB)

N68-21473# Wisconsin Univ., Madison. Mathematics Research Center.

GENERALIZATION OF SCHWARTZ-PICK LEMMA TO INVARIANT VOLUME IN A KAEHLER MANIFOLD, 2.

K. T. Hahn and Josephine Mitchell Oct. 1967 13 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-796; AD-666191)

The Ahlfors version of the Schwartz-Pick lemma for one complex variable is extended to bounded homogeneous Siegel domains of second kind which can be mapped biholomorphically into Kahler manifolds of a certain class. Author (TAB)

N68-21491# Wisconsin Univ., Madison. Mathematics Research Center.

ERROR ESTIMATES FOR ASYMPTOTIC REPRESENTATIONS OF INTEGRALS

John J. Mahony Aug. 1967 23 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-754; AD-666192)

Minimum errors of asymptotic expansions of integrals taken between the limits a, b, of the quantity (exp(kg(u)) f(u) du) for large positive values of k, achievable by appropriate curtailment of the expansions are considered. TAB

N68-21507# Massachusetts Inst. of Tech., Cambridge. Mass. Research Lab. of Electronics.

A STATE-VARIABLE APPROACH TO THE SOLUTION OF FREDHOLM INTEGRAL EQUATIONS

Arthur B. Baggeroer 15 Nov. 1967 73 p refs

(Contracts DA-28-043-AMC-02536(E); N00140-67-C-0210)

(TR-459; AD-666215)

A method of solving Fredholm integral equations of the second kind by state-variable techniques is presented. The principal advantage of this method is that it leads to efficient computer algorithms for calculating numerical solutions. The only assumptions that are made are (a) the kernel of the integral equation is the covariance function of a random process; (b) this random process is the output of a linear system having a white noise input; (c) this linear system has a finite dimensional state-variable description of its input-output relationship. Both the homogeneous and nonhomogeneous integral equations are reduced to two linear first-order vector differential equations plus an associated set of boundary conditions. The coefficients of these differential equations follow directly from the matrices that describe the linear system. In the case of the homogeneous integral equation, the eigenvalues are found to be the solutions to a transcendental equation. The eigenfunctions also follow directly. In the case of the nonhomogeneous equation, the vector differential equations are identical to those obtained in the state-variable formulation of the

optimum linear smoother. In both cases analytical and numerical examples are presented. Finally, the optimum linear smoother (unrealizable filter) structure is derived by using a new approach. In this approach, the filter is required to be linear; then the resulting Wiener-Hopf equation is used in conjunction with techniques developed in the report to find the differential equations and boundary conditions specifying the optimum estimate. Author (TAB)

N68-21510# RAND Corp., Santa Monica, Calif.
APPROXIMATING ONE CONVEX FUNCTION BY ANOTHER
Jon Folkman and Norman Shapiro Feb. 1968 19 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5565-PR; AD-666415)

The report describes a simple iterative procedure for approximating one convex function, relative to a given constraint set, by another convex function, having the same constraint set, plus an appropriate linear function. This procedure is particularly useful when efficient digital computer programs are already available for minimizing functions that differ from some other convex function by a linear function. A theorem is presented that gives sufficient conditions for such a procedure to succeed. Author (TAB)

N68-21548# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE P-RANK OF THE DESIGN MATRIX OF A DIFFERENCE SET
F. J. Mac Williams and H. B. Mann Oct. 1967 190 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-803; AD-666190)

The rank mod p (a prime) of the incidence matrix of the Euclidean and projective hyperplanes is determined. Similar results are obtained for certain other design matrices. Author (TAB)

N68-21555# RAND Corp., Santa Monica, Calif.
ON THE DISTRIBUTION OF THE MOST SIGNIFICANT HEXADECIMAL DIGIT
Stanley Azen and John Derr Feb. 1968 48 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5496-PR; AD-666414)

The report describes an investigation of the distribution of the most significant hexadecimal digit of numbers produced through scientific computing with the IBM-360 computer. Theoretical results are derived for the operations of multiplication, division, and addition (subtraction); these are compared, in some cases, with experimental results. It is shown that after certain sequences of operations, the distributions tend to be stable in the most significant hexadecimal digit and uniform in the number of leading zero binary bits in that digit. This leads to the uniform binary distribution, a very simple formula for obtaining the distribution of the leading hexadecimal digit d. Applications of the results of the study to truncation error analysis and function approximation are given. Author (TAB)

N68-21571# Parke Mathematical Labs., Inc., Carlisle, Mass.
THE SKELTONS OF STABLE PLANE SETS Interim Scientific Report
L. Calabi and J. A. Riley Dec. 1967 43 p refs
(Contract AF 19(628)-5711)
(SR-3; AFCRL-68-0025; AD-666039)

Necessary and sufficient conditions are formulated for the skeleton of a set A to be essentially, a well behaved graph. Differentiability properties of that graph and of the quench function are established. Author (TAB)

N68-21572# Wisconsin Univ., Madison. Mathematics Research Center.
NEWTON: A GENERAL PURPOSE PROGRAM FOR SOLVING NONLINEAR SYSTEMS
Julia H. Gray and L. B. Rall Sep. 1967 54 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-790; AD-666189)

A computer program is described for solving nonlinear systems of equations by Newtons method on the CDC 3600. The program features automatic analytic differentiation for the construction of the Jacobian matrix, and automatic error analysis at the option of the user. Author (TAB)

N68-21587# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NUMERICAL INTEGRATION OF "STIFF" EQUATIONS
Henry P. Jung Mar. 1967 16 p refs
(Rept.-67SD245)

An integration algorithm for simultaneous differential equations has been developed which approximates the integral curve by simple exponential functions. The programmed algorithm utilizes the first derivative which must be evaluated at five points in each interval and thus parallels the fourth order Runge–Kutta–Merson Method. The ability to use a large step size is facilitated by the use of an error formula which is stated in the development of the algorithm. Also, the more stiff the system of equations, the more efficient is the algorithm and the larger the integration step size. The algorithm also has an excellent use when the system of equations approaches an asymptote. Author

N68-21596# Wisconsin Univ., Madison. Mathematics Research Center.
UPON THE DEFINITION OF AN INTEGRAL AS THE LIMIT OF A CONTINUED FRACTION
P. Wynn Aug. 1967 115 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-670; AD-666193)

A new definition of the integral taken between the limits t and infinity of the quantity phi(xi) d(xi) is discussed. The definition is based upon the theory of continued fractions. Author (TAB)

N68-21614*# Stanford Univ., Calif. Dept. of Statistics.
NONPARAMETRIC RANKING PROCEDURES FOR COMPARISON WITH A CONTROL
M. Haseeb Rizvi, Milton Sobel, and George G. Woodworth 22 Feb. 1968 42 p refs
(Grants NGR-36-008-040; NSF G-3183; Contracts Nonr-225(52); Nonr-225(53))
(NASA-CR-94123; TR-133; AD-666115) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A decision maker is confronted with k populations pi sub 1,...,pi sub k (say, k lots of items available for purchase) and a control population pi sub o and must, on the basis of random samples of common size from pi sub o,...,pi sub k, select those which are at least as good as pi sub o. A nonparametric procedure R based on order statistics is proposed as a solution for this problem; R guarantees with a preassigned probability P* that, when each pi sub i is stochastically ordered with respect to pi sub o, all populations better than pi sub o will be selected. TAB

N68-21646# Case Western Reserve Univ., Cleveland, Ohio. Systems Research Center.
SOME RESULTS IN A THEORY OF PROBLEM SOLVING
Ranan B. Banerji Nov. 1967 155 p refs Prepared jointly with Princeton Univ.
(Contract AF 49(638)-1184; Grants AF-AFOSR-125-67; AF-AFOSR-125-65; NSF GK-1386; NSF GK-185 et al)
(SRC-126-A-67-59; AFOSR-68-0346; AD-666043)

The document contains the first three chapters of a book expected to be published in 1968. The book will consider certain methods for finding solutions to problems and games and their relationship to pattern recognition. The framework of elementary set theory is used to enable the relationship to be discussed in a

common mathematical framework. The models of problems and two-person games are specializations of a model that can be viewed as well as a general model of control systems. Unlike von Meumanns model of extended games, the present model is not a tree but an automaton or labeled directed graph. The treatment in this document suggests that the practical application of any solution strategy needs succinct descriptions of certain subsets of the state space of the control problem. The idea of description has been formalized, and the importance of description languages is discussed. Techniques for constructing solution strategies are presented, and the sets associated with their application are precisely defined. Author (TAB)

N68-21665# RAND Corp., Santa Monica, Calif.
MULTIPROJECT SCHEDULING WITH LIMITED RESOURCES: A ZERO-ONE PROGRAMMING APPROACH
A. Alan B. Pritsker, Lawrence J. Watters, and Philip M. Wolfe (Arizona Univ., Tucson) Feb. 1968 33 p refs
(P-3800; AD-666412)

A zero-one (0-1) linear programming formulation of multiproject and job-shop scheduling problems is presented that is more general and computationally tractable than other known formulations. It can accommodate a wide range of real-world situations including multiple resource constraints, due dates, job splitting, resource substitutability, and concurrency and nonconcurrency of job performance requirements. Three possible objective functions are discussed: minimizing total throughput time for all projects; minimizing the time by which all projects are completed (i.e., minimizing makespan); and minimizing total lateness or lateness penalty for all projects. Author (TAB)

N68-21729*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ON THE LOCAL STRUCTURE OF HYPERBOLIC POINTS IN BANACH SPACES
J. Palis [1967] 8 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67)
(NASA-CR-94098) CFSTI: HC$3.00/MF$0.65 CSCL 12A

It has been proved that a diffeomorphism or a flow on R^n with a hyperbolic fixed point is locally topologically equivalent to its linear part. In this paper we extend this theorem for Banach spaces. We shall make use of a key idea presented by Moser where he gave a new proof of the structural stability of the Anosov diffeomorphisms. As in the finite dimensional case, we do not need to assume the existence of invariant manifolds associated to the fixed point. Author

N68-21790 California Univ., Los Angeles.
IDENTIFICATION OF LINEAR STOCHASTIC DYNAMICAL SYSTEMS BY NONLINEAR WEIGHTING OF NOISY MEASUREMENTS
Walter Henry Kroy, Jr. (Ph.D. Thesis) 1968 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-8405

The identification of linear time invariant stochastic dynamical systems is made for the class of systems where the plant is characterized by either a scalar random parameter or a matrix of random parameters with known distributions. The initial state is assumed gaussian with known mean and variance. White gaussian disturbing noise with zero mean and known variance is acting on the dynamical system. The state of the system is observed under the influence of another white gaussian noise process. The statistics are assumed independent of each other. The criterion for optimality is the minimum mean square error. Both discrete and continuous dynamical systems are considered. Expressions for the Bayes or minimum mean square estimate are developed. Dissert. Abstr.

N68-21809# Environmental Science Services Administration, Silver Spring, Md. Environmental Data Service.
DIRECT AND INVERSE TABLES OF THE GAMMA DISTRIBUTION
H. C. S. Thom Apr. 1968 34 p refs
(EDS-2) CFSTI: HC$3.00/MF$0.65

Previous tables of gamma distribution have arguments related to the moments which are not natural parameters of the distribution and are, therefore, not very convenient to use when one has direct estimates of scale, shape, and location as given by modern practice. The present tables have a unit scale argument for a range of shape suitable for climatological work. They also have another innovation in that there is an inverse table for both the integral and the probability density function for a limited set of probabilities. Computation of these tables was done on the Mathatron. Author

N68-21824*# Texas Univ., Austin. Center for Research.
AN INTRODUCTION TO THE THEORY OF GENERALIZED MATRIX INVERTIBILITY
Thomas L. Boullion and Patrick L. Odell 1966 309 p refs
(Contract NAS9-2619)
(NASA-CR-62058) CFSTI: HC$3.00/MF$0.65 CSCL 12A

An attempt to assimilate available literature on the pseudo invertibility of matrices is reported. An exposition of several definitions of a pseudo inverse of a matrix is given, and the equivalance or near equivalence of these definitions is established. Properties of the Penrose pseudo inverse are established and an attempt made to present alternative forms and formulations while at the same time keeping the presentation as comprehensible as possible so that a minimum of preparation and effort are required. Also established are properties of the Scroggs–Odell pseudo inverse. Pseudo inverses in general are investigated and the relationship between any two pseudo inverses is established. Necessary and sufficient conditions for the Scroggs–Odell and Penrose definitions to be equivalent over their common domain of definition are also established. S.C.W.

N68-21829*# Texas Univ., Austin. Center for Research.
INTERVAL ESTIMATION OF A STIMULUS LEVEL OF ORDER α IN SENSITIVITY TESTING
Lakshmi Tatikonda 1 Jun. 1966 76 p refs
(Contract NAS9-2619)
(NASA-CR-62057) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Methods used in quantitative measurements of responses attributed to the action of the stimulus in stimulus-subject systems are reviewed, and a new method for obtaining confidence limits on order alpha in up and down testing is described. Methods reviewed include the Spearman–Karber technique; the Dixon–Mood technique; and Ferrell's technique. The proposed method is a modification of Odell's method for the stochastic approximation and nonparametric interval estimation in sensitivity testing which involves quantal response data. An empirical study of the sample size for a fixed confidence level and for a preassigned length of the interval is made and comparative data on the effectiveness of the proposed method vs existing methods for analyzing sensitivity data are included. S.C.W.

N68-21837*# Texas Univ., Austin. Center for Research.
A THEORY OF LINEAR ESTIMATION
T. O. Lewis (Tex. Technol. Coll.) and P. L. Odell [1967] 163 p refs
(Contract NAS9-2619)
(NASA-CR-62053) CFSTI: HC$3.00/MF$0.65 CSCL 12A

A theory of linear estimation from a non-parametric point of view is developed (i.e. with no assumptions concerning the underlying probability density functions associated with the errors in the data); and the applicability of the proposed theory to problems in smoothing, filtering, extrapolation, and nonlinear estimation is

discussed. Considered are: mathematical concepts; minimum variance linear unbiased estimation; a generalization of the Gauss–Markov theorem; the Gauss–Markov theorem and its relation to continuous recursive estimation; matrix lower bound for the covariance matrix of a vector estimate; best linear unbiased estimation by recursive methods when the observations are correlated; the selection of sample points; linear estimation with linear constraints; linear estimation with inequality constraints; recursive estimation when the covariance matrix is unknown; maximum likelihood estimates; and combined unbiased vector estimators of a vector parameter.
S.C.W.

N68-21843*# Texas Univ., Austin. Center for Research.
ON THE GENERATION OF PSEUDO-RANDOM NUMBERS FROM SEVERAL NON-UNIFORM DISTRIBUTIONS
Rosser J. Smith, III [1967] 35 p refs
(Contract NAS9-2619)
(NASA-CR-62051) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Methods for generating pseudo-random numbers representing several of the fundamental statistical distributions are described. Focused on are methods for generating random numbers from other distributions. Several of the methods are readily adapted to automated computation, and several are suitable for manual computation where only a moderate sample size is required. Most of the proposed methods, however, require a supply of random numbers having a uniform distribution over the interval [0,1].
S.C.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-20769# RAND Corp., Santa Monica, Calif.
BIGHT-SIZE FLOW PATTERNS
C. Schutz and R. R. Rapp Feb. 1968 20 p refs
(P-3750; AD-665452)

During the 18 months from March 1966 to August 1967, yachtsmens wind reports were used, along with regularly received coastal and island reports, to establish three typical streamline patterns over the Southern California bight. Although this was far from a rigorous analysis, it was found that these mesoscale (bight-size) patterns could be correlated with synoptic patterns and associated pressure differences between Los Angeles and Daggett, and Los Angeles and San Francisco. Also, it was determined that the upper flow, at and below 500 mbs, has a direct bearing on the streamlines. It is therefore postulated that through the use of this knowledge and the daily 12- and 24-hour prognostic charts, local changes in the offshore flow can be forecast more definitively by forecasters and yachtsmen alike. Author (TAB)

N68-20891 Texas A&M Univ., College Station.
A METEOROLOGICAL MODEL FOR FORECASTING THE WIND-PROFILE BETWEEN 1.0 AND 18.0 KILOMETERS
Kenneth Doyle Hadeen (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-4703

A meteorological model for making short period wind profile forecasts in the tropospheric and lower stratospheric regions has been formulated and tested. A general purpose analog computer was used for the initial development and subsequent modification of the model. The resulting digital suitability of the final form of the model permitted verification as well as input data processing with an IBM 7094. Testing of the model, under varying meterological conditons, was conducted in the geographical areas centered on Bedford, Massachusetts and Fort Worth, Texas. Initial testing utilized routine upper air data and, as expected, the quality, frequency, and spatial density of these data severely affected the applicability of the model. The primary limiting factor is the restricting but necessary assumption of steady state boundary conditions based on finite differencing of local observations which are seldom spatially and temporally representative. Subsequent testing showed that the model, if used in conjunction with the National Meteorological Center's three level model for the Northern Hemisphere, will give acceptable meso-scale upper air wind forecasts. Dissert. Abstr.

N68-20956# Weather Bureau, Silver Spring, Md.
CLIMATOLOGICAL PROBABILITIES OF PRECIPITATION FOR THE CONTERMINOUS UNITED STATES
Donald L. Jorgensen Dec. 1967 65 p refs
(WB-5) GPO: $0.40

Climatological probabilities, as represented by observed frequencies, have been generated for 6-, 12-, and 24-hour periods for 108 stations distributed over the conterminous states. A 15-year period of record was used which included the years 1949 to 1964. The restuls are presented in the form of plotted data with smoothed topographically dependent analyses giving seven charts for each month, for a total of 84 charts. Seasonal and diurnal trends in the observed data are discussed briefly in terms of the synoptic and topographical influences for various regions of the country. Frequencies of precipitation occurrence are strongly influenced in a unique manner by topographic and synoptic influences, with extreme variability observed in the western states. Smooth patterns are observed in the Great Plains with the pattern further distorted by the mountains in the East. Seasonal trends in precipitation occurrence are influenced by the shifting tracks of cyclonic systems in the fall–winter–spring period, with a transition to thunderstorm precipitation during the summer months. Author

N68-20964# Federal Aviation Agency, Atlantic City, N. J. Dept. of Transportation.
CLEAR AIR TURBULENCE: A BIBLIOGRAPHY, 1950–1967 Final Report
Dorothy E. Bulford Mar. 1968 80 p refs
(NA-68-17)

Clear air turbulence encounters can occur unexpectedly without any visual evidence or warning. As operations of higher altitude aircraft increase, the phenomenon is encountered more often. CLEAR AIR TURBULENCE is defined as "all turbulence in the free atmosphere of interest in aerospace operations that is not in or adjacent to visible convective activity (this includes turbulence found in cirrus clouds not in or adjacent to visible convective activity)." This bibliography consists of 578 references to technical reports, articles in periodicals, and books published during the past 17 years. References about other forms of turbulence such as that occurring with storms and airplane wake vortices are not included.
Author

N68-21278# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 178 17 Apr. 1968 p 17–41 refs (See N68-21276 11-13)

Summary data, abstracts, and some full translations are presented from Sino-Soviet bloc meteorological publications. Complete bibliographic data accompanies each article. Included are: news articles on hysometers for radiosondes, factors affecting the altitude of radiosonde balloon ascents, optical properties of the atmospheric boundary layer, turbulence and vertical air currents in boundary layers, and thermoelectric pyrheliometer, an absolute balance-meter and compensation pyranometer, and use of M-63

anemorhumbometers; book reviews on numerical weather forecasting techniques, variations in the general circulation of the atmosphere, a hydrological study of the Lena River estuary, fluctuations of the hydrometeorological regime in the USSR, the microclimate of humid mountain valleys, radar meteorology, the Caucasian anti-hail expedition of 1965, and the climate of the Ukraine; abstracts of scientific articles on stationary mesoscale waves, attenuation of solar radiant energy, tidal waves, wind gustiness in the lower atmosphere, radar wind measurements, infrared cloud photography, and thermodynamic conditions preceding thunderstorm development. E.J.S.

N68-21307# Crop Hail Insurance Actuarial Association, Chicago, Ill.

CLIMATOGRAPHY OF HAIL IN THE CENTRAL UNITED STATES

Glenn E. Stout and Stanley A. Changnon, Jr. 29 Feb. 1968 47 p refs

(CHIAA-RR-38)

Average number of days with hail during each month and for the entire year are depicted in 13 maps that are based on data accumulated for the central part of the United States over a 20-year period. Additional maps indicate the average number of days with hail over 10-year periods from 1901 through 1960. Relecant features, their likely causes, and maximum point thunder-hail ratios are discussed; and the maps depicting hail climatography during the various decades of the 20th century illustrate the area-temporal variability of hail in the central portion of the country. Data for the maps were derived from recordings at 1285 weather stations in 17 states. M.W.R.

N68-21436# Weather Wing (1st), San Francisco, Calif.

RECURRING EASTERN ASIATIC SYNOPTIC FEATURES, PART 1

Andy Waters Oct. 1967 34 p *Its* Tech. Study No. 14

(AD-666260)

Synoptic models designed to improve weather forecasts in the Tokyo, Japan area are presented. The most important weather producers for Tokyo are low pressure centers which develop near Shanghai, China, and in the Yellow and East China Seas. Rugged terrain over Eastern Asia reroutes and distorts synoptic features approaching Japan from the west. The more important geographical effects and the clues they give to low development are discussed. The development of mesoscale features near Japan in advance of major lows is stressed. All synoptic features are named to identify their location or origin. Examples of development and movement of each feature are presented. Included are case studies of heavy snowfall, thunderstorms, typhoons, the rainy season (Bai-U), extended poor flying weather, etc., affecting Tokyo. Preliminary relationships are established between frontal surges over Southeast Asia and passage of synoptic features near Tokyo. Brief climatological summaries of Tokyo area weather and monthly typhoon frequency are included. Long wave patterns are related to Tokyo weather in generalized form. Author (TAB)

N68-21528# Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIOACTIVE ISOTOPES AND THEIR USE IN METEOROLOGY

I. L. Karol', ed. 1967 377 p refs Transl. into ENGLISH of the Publ. "Radioaktivnye Izotopy v Atmosfere i Ikh Ispol'zovanie v Meteorologii" Moscow, Atomizdat, 1965 p 1–491 Presented at Conf. on Nucl. Meteorol., Obninsk, 3–6 Feb. 1964 Published for AEC and NSF

(AEC-TR-6711; CONF-640208) CFSTI: HC $3.00/MF $0.65

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2. PROPERTIES AND COMPOSITION OF RADIOACTIVE AEROSOLS BEARING NUCLEAR EXPLOSION PRODUCTS AND THEIR WASH-OUT FROM THE ATMOSPHERE p 112–174 refs (See N68-21528 11-20)

3. GLOBAL SPREAD AND FALLOUT OF NUCLEAR EXPLOSION PRODUCTS p 175–285 refs (See N68-21529 11-20)

4. RADIOACTIVE CONTAMINATION OF SURFACE AIR BY LOCAL SOURCES p 286–302 refs (See N68-21530 11-20)

5. INSTRUMENTATION AND TECHNIQUE OF MEASURING RADIOACTIVE CONTAMINATION OF THE EXTERNAL ENVIRONMENT p 303–366 refs (See N68-21531 11-20)

N68-21527# Israel Program for Scientific Translations, Ltd., Jerusalem.

NATURAL RADIOACTIVITY OF THE ATMOSPHERE AND ITS USE IN THE STUDY OF METEOROLOGICAL PROCESSES

In its Radioact. Isotopes and Their Use in Meteorol. 1967 p 4–111 refs (See N68-21526 11-20)

The problems involved in distinguishing between natural and artificial radioactivity of the atmosphere are examined in the context of the distributions of the measured concentrations of radioactive emanations and of their decay products in the atmosphere. Data on measurements of radon emanation and concentration in the soil and in air are presented, along with information on the seasonal variations in radon and thoron concentrations in the surface layer of the atmosphere. The effects of advection and vertical exchange on the atmospheric distribution of natural radioactive substances are assessed. Variations in lead-210 content in the atmosphere, and its planetary distributions, are considered. The use of these data for studying meteorological processes on various scales is described. M.G.J.

N68-21528# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROPERTIES AND COMPOSITION OF RADIOACTIVE AEROSOLS BEARING NUCLEAR EXPLOSION PRODUCTS AND THEIR WASH-OUT FROM THE ATMOSPHERE

In its Radioact. Isotopes and Their Use in Meteorol. 1967 p 112–174 refs (See N68-21526 11-20)

Experimental data on the dispersity of radioactive aerosols in the stratosphere and troposphere are reviewed, and emphasis is placed on the need for improving the theoretical models of radioactive particle formations in nuclear explosions. Fractionation mechanisms are defined, and the values which characterize the fractionation of fission products for ground level explosions of different power are calculated. Washout of radioactive aerosols by clouds and precipitation is discussed in terms of the mechanisms by which precipitation elements acquire radioactivity. The physicochemical properties of artificial radioactive aerosols in the atmosphere are presented, with particular attention given to the hot alpha-radiating aerosol particles. M.G.J.

N68-21529# Israel Program for Scientific Translations, Ltd., Jerusalem.

GLOBAL SPREAD AND FALLOUT OF NUCLEAR EXPLOSION PRODUCTS

In its Radioact. Isotopes and Their Use in Meteorol. 1967 p 175–285 refs (See N68-21526 11-20)

Measurement data are presented on the level of radioactive contamination of the atmosphere, and of fallout from nuclear explosions at various points in the Soviet Union and abroad. These results are applied to synoptic investigations, and to such problems of general atmospheric circulation as the exchange between Northern and Southern Hemispheres, between the stratosphere and the troposphere, and interlatitudinal exchange in the polar region.

Meteorological factors, which control the planetary distribution of radioactive products in the atmosphere and their deposition on the earth's surface, are discussed. Consideration is also given to a technique for global radioactive fallout forecasting. M.G.J.

N68-21530# Israel Program for Scientific Translations, Ltd., Jerusalem.
RADIOACTIVE CONTAMINATION OF SURFACE AIR BY LOCAL SOURCES
In its Radioact. Isotopes and Their Use in Meteorol. 1967 p 286–302 refs (See N68-21526 11-20)

The effect of meteorological factors on the height of chimneys designed for discharging gases and smoke is assessed, and an atmospheric diffusion theory is developed which allows for possible variations in lapse rate, wind velocity, and exchange coefficient. To calculate the spreading of a settling impurity in surface air under different meteorological conditions, simulation experiments were conducted with a 300-meter meteorological tower. Measurements were made of the mean wind profiles, wind direction, temperature profiles, and some turbulence characteristics. Gradient observations in the surface layer of the atmosphere were also conducted. Such trail parameters as the distance from the source epicenter to the maximum density, the maximum density, and the trail dimensions are identified. M.G.J.

N68-21531# Israel Program for Scientific Translation, Ltd., Jerusalem.
INSTRUMENTATION AND TECHNIQUE OF MEASURING RADIOACTIVE CONTAMINATION OF THE EXTERNAL ENVIRONMENT
In its Radioact. Isotopes and Their Use in Meteorol. 1967 p 303–366 refs (See N68-21526 11-20)

The mechanical and physicochemical properties of various fibrous filtering materials are discussed in terms of their retention capacity for aerosols of any dispersity, and their selection parameters for various applications. The physical principles of the radiation sedimentation method for establishing particle activity distribution are described, and problems encountered in estimating the accuracy of the results are examined. Optimum conditions for measuring a radioactive preparation are delineated. Experimental details are given on the apparatus used for measuring ultralow alpha activities, an airborne adsorption method of determining radon concentrations, cloud water sampling by means of a circulating precipitator, and the use of horizontal boards for a more precise determination of the coefficients of aerosol collection. It was concluded that important successes have been achieved in the fields of radiometry and radiochemistry, by the use of such methods as gamma-spectometric analysis of radioactive mixtures, and flame photometry for the radiochemical analysis of samples. M.G.J.

N68-21586# Dayton Univ., Ohio. Research Inst.
THE BALLUTE: A RETARDATION DEVICE AND WIND SENSOR
James K. Luers Nov. 1967 38 p refs
(Contract AF 19(628)-4796)
(UDRI-TR-67-144; SR-3; AFCRL-67-0659; AD-666021)

Experimental tests have been made with various configurations of the BALLUTE in order to develop a stable retardation device for meteorological rocketsondes. This report discusses the reduction and analysis of these tests. Several of the BALLUTE configurations are shown to satisfy the project goal of providing the required stability as well as a sufficiently slow fall velocity to accurately measure winds and temperature. Author (TAB)

N68-21595# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WORK RESULTS OF LIQUID PRECIPITATION MEASUREMENT BASED ON RADAR [O REZUL'TATAKH RABOT PO IZMERENIYU ZHIDKIKH OSADKOV RADIOLOKATSIONNYM METODOM]
A. M. Dimaksyan and N. V. Zotimov 24 Aug. 1967 17 p refs Transl. into ENGLISH from Tr. Gos. Gidrolog. Inst. (Leningrad), no. 130, 1965 p 122–131
(FTD-MT-24-171-67; AD-666076)

The possible use of radar in measuring total amount and intensity of liquid precipitation is discussed. The correlation between the magnitude of the radar echo signal and the intensity of precipitation is established. Using a differential calibration method, a radar installation can measure rain intensity for any season of the year. This calibration is applicable to any kind of radar station. It is concluded that in order to record precipitation during any period of the year (for a 100 km radius) it is necessary to have radar transmitters and receivers with a sensitivity 20 times greater than the existing models. The combined use of amplitude analyzers and computers is recommended. Author (TAB)

N68-21748# Weather Wing (1st), San Francisco, Calif.
RECURRING EASTERN ASIATIC SYNOPTIC FEATURES. PART 2: FIGURES
Andy Waters Oct. 1967 294 p *Its* Tech. Study 14
(AD-666096)

Figures showing synoptic feature geography, storm tracks, and a composite map of recurring synoptic features relevant to weather forecasting for Tokyo, Japan are presented. TAB

N68-21827 National Academy of Sciences—National Research Council, Washington, D. C. World Data Center A.
METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME 4, NUMBER 6, JUNE 1967 Data Report
Asheville, N. C. Environ. Sci. Serv. Admin. 1968 343 p

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-20683 New Mexico Univ., Albuquerque.
PRINCIPAL ERROR AXES AND OPTIMIZATION OF ACCELEROMETER MOUNTING ANGLES IN INERTIAL GUIDANCE SYSTEMS
Julian S. Nichols (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-6240

During World War II, the Germans formulated an engine cutoff procedure for the V-2 which involved the use of two integrating accelerometers. They were conceived as being mounted on a stabilized platform at two different, non-orthogonal angles with respect to the launch vertical. This is a study of the physical significance and the guidance implications of the two accelerometer mounting angles. The rudiments of a pitch plane inertial guidance system which utilizes the principal error axes concept are presented.

A procedure is developed for determining the optimum orientation of accelerometers in the principal error axes guidance system so as to minimize down-range miss. This procedure is based on the definition of the principal error axes and on the fact that the principal error axis for velocity coincides with the optimum thrust direction. Dissert. Abstr.

N68-20757# Scanwell Labs., Inc., Springfield, Va.
VORTAC PERFORMANCE IN A SNOW AND ICE ENVIRONMENT Final Report
Clinton G. Hollins Feb. 1968 138 p refs
(Contract FA-65-WA-1316)
(SRDS-RD-68-3; AD-665814)

Investigations into the performance of VORTAC installations operating in an adverse snow and ice environment are described. VOR system performance is analyzed using a computational program for determining the course errors produced by sections of a thin spherical shell centered on the antenna system. A near field formulation of the electromagnetic problem allows simultaneous computation of the course error curves for both ground checks and aircraft orbits. Specific examples of course error curves and graphical summaries of the variation in maximum course error as the parameters describing the scatterer are altered provide a foundation for discussion of the more significant distributions of snow. Natural accumulations are shown to be capable of producing out-of-tolerance conditions accompanied by inadequate monitoring. Possible solutions for the problem are briefly discussed. The results of thermal tests performed on a TACAN transmitting antenna in order to determine the deficiencies present in the existing deicing system are evaluated. Modifications of the TACAN and VOR monitor antennas which will eliminate unwarranted outages due to ice and snow accumulation on the antenna covers are described along with the results of tests on the modified equipment. Author (TAB)

N68-20809# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
AN/AYA-4 LORAN-C HYPERBOLIC COORDINATE CONVERTER SET Final Report, Jun. 1965–Jun. 1967
D. Wozniak, W. Craig, H. Feikema, and N. Harnisch Jun. 1967 126 p Sponsored jointly with U. S. Coast Guard
(Contract FA-WA-4659)
(GRR-67-1314-1; RD-67-31-1; AD-665781)

The report describes the design, development and flight testing of the AN/AYA-4 Navigation Computer Set. Section 1 describes the objectives of the contract, the design configuration, and the problems encountered. Section 2 contains a summary of the report along with recommendations and conclusions. Author (TAB)

N68-21123*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIGATOR PERFORMANCE STUDIES FOR SPACE NAVIGATION USING THE NASA CV-990 RESEARCH AIRCRAFT
Richard A. Acken and Donald W. Smith Washington Apr. 1968 20 p refs
(NASA-TN-D-4449) CFSTI: HC$3.00/MF$0.65 CSCL 17G

Manually operated hand-held sextants are being studied to determine whether they are sufficiently accurate for midcourse navigation phases of manned space flight. Studies carried out on the ground have been extended by using the NASA CV-990 aircraft to provide sighting conditions closely simulating those in spacecraft and to investigate further the measurement error due to lunar irradiance. The results of approximately 1200 measurements made during nine flights confirm results of simulator and ground-based studies which indicate that, with a hand-held sextant, an astronaut can be expected to make navigational measurements with errors having a standard deviation of approximately ±10 arc seconds. A value for moon irradiance effect of approximately 25 arc seconds was established for the conditions of the experiment using a hand-held sextant. Author

N68-21238*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY. 12: INERTIAL GUIDANCE SYSTEMS
Daniel J. Shramo Washington 1968 24 p refs Presented at Lewis Aerospace Explorers Conf., Cleveland, 1966–1967
(NASA-TM-X-52399) CFSTI: HC$3.00/MF$0.65 CSCL 17G

The basic inertial navigation system is defined as a system whose orientation is fixed, whose input is a physical acceleration, and whose output is the vehicle's present position. Consideration is given to the three major components for converting acceleration to position; the inertial reference unit, the acceleration sensing unit, and computing unit. The inertial reference unit is evaluated, and details are given on the functions and operating mechanisms of the gyroscope portion of the unit. The problems associated with gyroscopic drift are also examined. The acceleration sensing unit is discussed in relation to the basic design, function, and performance of the accelerometer, which is for measurement of both direction and magnitude of a force. An assessment is also made of the computing unit which receives signals from the accleration unit and converts them to the distance and direction information that is needed to determine vehicle position. Some basic components of the inertial guidance system for the Centaur launch vehicle are shown along with block diagrams to illustrate the functions of each. B.S.D.

N68-21366*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDY OF PILOT CONTROL OVER THE LUNAR MODULE DURING ASCENT FROM THE LUNAR SURFACE BY USING VISUAL GUIDANCE CUES
Herman S. Fletcher, L. Keith Barker, and Gary P. Beasley Washington Apr. 1968 33 p refs
(NASA-TM-X-1549) CFSTI: HC$3.00/MF$0.65 CSCL 05H

A fixed-base simulator study was conducted to determine the ability of pilots to use a simple, visually guided piloting procedure to inject the ascent stage of the lunar module into a safe transfer orbit which had an apocynthion altitude of 80 nautical miles (148.16 kilometers). The pilot had control of the thrust along the longitudinal axis by means of an on–off switch and of the vehicle attitude by means of a rate-command or a rate-command–attitude-hold control system. The guidance procedure required the pilot to maintain three consecutive constant angles between the thrust axis and the line of sight to the down-range horizon, and to use an integrating accelerometer to indicate when to change the vehicle pitch attitude and when to terminate the thrust. While the tasks required for a simulated launch and transfer-orbit injection were performed by using visual references for guidance, resulting transfer orbits depended on the thrust alignment with the center of gravity and the type of control system. Appreciable pilot-control problems were created when the rate-command control system was used in combination with thrust misalignment, nonvertical-launch effects were of no consequence and easily controlled, and thrust errors as large as 2 percent did not affect the safety of the ascent. Author

N68-21467# Royal Aircraft Establishment, Farnborough (England).
A TWO-GYRO SEMI-PASSIVE ATTITUDE CONTROL
N. E. Ives Mar. 1967 82 p refs
(RAE-TR-67078; AD-666522)

The report is concerned with an earth-pointing satellite (in a circular orbit) making use of gravity gradient stabilization. A pair of gyros act as control elements by providing damping of attitude motion. The gyros are not torqued in any way; they are free to process relative to the satellite except for spring and viscous damper constraints applied to the gimbals. Attitude motion is

damped by energy dissipation in the viscous medium as a result of relative motion between gimbals and satellite. Power must be supplied to drive the rotors of the gyros which are referred to as semi-passive control elements. The aim of the study was to investigate the possibility of using a pair of damper gyros to bring a satellite into an earth-pointing attitude from the angular rates which may exist at orbit injection, or which may be initiated as a result of meteoric impacts at a later stage of the satellites life. It is found that for a particular design of a two-gyro damper, earth-pointing stabilization is achieved from an arbitrary initial attitude and a limited range of attitude rates. Author (TAB)

N68-21652*# United Aircraft Corp., Farmington, Conn.
A STUDY OF THE CRITICAL COMPUTATIONAL PROBLEMS ASSOCIATED WITH STRAPDOWN INERTIAL NAVIGATION SYSTEMS
Washington NASA Apr. 1968 217 p refs
(Contract NAS12-91)
(NASA-CR-988; SCR-328-1) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A detailed and comprehensive evaluation of the computational processes of strapdown inertial navigators are reported; the computational requirements and error sources are defined, and analytic models of the computational errors are developed. The analytic computational error models were developed with the aid of detailed digital simulations of the flight environment, the strapdown inertial sensors, the computer hardware and the numerical processes. The strapdown computational processes investigated were the determination of attitude, the resolution of accelerometer data into the inertial frame and the computation of position. Author

N68-21715# Bolkow Entwicklungen K. G., Munich (West Germany).
SATELLITE ATTITUDE CONTROL SYSTEM, USING INTEGRATING GYROS AS TORQUERS [SATELLITEN-LAGERELUNGSSYSTEM MIT INTEGRIERENDEN KREISELN ALS MOMENTENGEBER]
L. Hawlitschek Bundesministerium fuer Wiss. Forsch. Dec. 1967 29 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-41) CFSTI: HC $3.00/MF $0.65

This report considers the use of integrating gyros as torque sources for precise control of satellite attitude. In addition to an analytical design an analog computer study was made. The results of the two considerations agreed well. It is shown that the integrating gyro produces a torque which is direct proportional to the error signal and to the vehicle rate. The gyro may be thought of as two devices in one, as a rate sensor and an actuator, so that no rate stabilization networks are required. Author

N68-21754*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NAVIGATION AND GUIDANCE ANALYSIS OF A MARS PROBE LAUNCHED FROM A MANNED FLYBY SPACECRAFT
Thomas B. Murtagh, Flora B. Lowes, and Victor R. Bond Washington Apr. 1968 70 p refs
(NASA-TN-D-4512) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This study was initiated with the probe and spacecraft separation at the Mars sphere of influence and was terminated with the probe arrival at a specified entry altitude and the spacecraft arrival at Mars periapsis. The disclosures of the study indicate that the results are decidedly dependent on the initial spacecraft errors at the time of separation and on the system model errors assumed when processing navigation data. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-20761# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SOLUTION OF THE STEADY-STATE DIFFUSION EQUATION USING GREEN'S FUNCTION
Norman E. Banks and G. Lansing Blackshaw Oct. 1967 29 p refs
(BRL-R-1374; AD-665378)

The one-velocity, one-dimensional, steady-state diffusion equation for a bare, spherical, neutron multiplying system containing a finite number of thin heterogeneities is formulated using a Heaviside representation for the spatial location of the heterogeneities. This Heaviside formulation is subsequently transformed to a Dirac delta function representation and Greens function techniques are applied to determine flux solutions and critical conditions for the general case of multiple heterogeneities and the special case of a single heterogeneity located at one-half the radius of the spherical assembly. Correlations between the materials and geometric bucklings of subcritical, critical, and supercritical systems are graphically presented and discussed. Author (TAB)

N68-20878# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
LIQUID METAL ENGINEERING CENTER (LMEC) Quarterly Technical Progress Report, Jul.–Sep. 1967
15 Nov. 1967 101 p ref
(Contract AT(04-3)-700)
(NAA-SR-12585) CFSTI: HC $3.00/MF $0.65

Progress in the development of engineering standards and practices for liquid metal systems and components is reported. Histories of sodium loop, valve, and pump failures are shown with recommendations for corrective action. Other activities such as monitoring and investigations of corrosion build-up, fuel handling devices, control rod drives, and fuel holddown mechanisms for sodium-cooled fast breeder reactors are described. Also discussed are results of studies on sodium flow-instrumentation and on development of electric resistance strain gages and transducer devices employing strain gages in or out of a sodium environment. NSA

N68-20892# Los Alamos Scientific Lab., N. Mex.
ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending Oct. 31, 1967
22 Dec. 1967 13 p refs
(Contract W-7405-ENG-36)
(LA-3835) CFSTI: HC $3.00/MF $0.65

Power profiles of the UHTREX core mockup are shown, graphically, as a function of position. Preliminary values for relative reactivity worths of U and (U–Th) fuels are given. Rod drop measurements for determination of neutron lifetime are described. Critical mass determinations are given; effects of perturbations on k_{eff} are tabulated as a function of perturbation. NSA

N68-20951# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES Quarterly Report, Jan.–Mar. 1967

Oct. 1967 116 p refs
(Contract AT(45-1)-1830)
(BNWL-472) CFSTI: HC$3.00/MF$0.65

Progress in various phases of work on the physics of reactors is reported in sections on reactor theory and code development, thermal reactors, fast reactors, critical mass physics, and neutron physics. Separate abstracts were prepared for each of the five sections. NSA

N68-20983# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NONDESTRUCTIVE TESTING OF ISOTOPE CONTAINMENT CAPSULES, SNAP-15A
R. W. Steffens and F. M. Coffman Jan. 1968 24 p ref
(Contract AT(45-1)-1830)
(BNWL-529) CFSTI: HC$3.00/MF$0.65

Ultrasonic nondestructive testing (NDT) was shown capable of providing quality assurance data on final capsules as well as information feedback for process control purposes. Ultrasonic NDT was investigated for monitoring the weld quality of the peripheral end-cap weld on SNAP-15A isotope containment capsules. Weld parameters of interest were weld penetration, cavities at the weld root, and intergranular cracking near the boundary of the recast weld volume. The ultrasonic techniques were evaluated by comparing metallographic data with the respective ultrasonic data obtained on five inert-core weld samples. Results showed that weld penetration could be measured with an accuracy of ±5% of full penetration. The basis for a technique to detect cavities at the weld root was established, and an ability to detect intergranular cracking was indicated. The scope of this investigation did not include full development of the ultrasonic tests. In addition to a description of the ultrasonic test that was found to be advantageous for monitoring the SNAP-15A weld parameters, weld evaluation data obtained by metallographic analysis are included along with additional NDT development requirements for more complete weld evaluation, and the test results obtained on six fueled capsules. Author (NSA)

N68-20985# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ADVANCED GRAPHITE FUEL SYSTEMS Annual Report, 15 May 1966–14 May 1967
J. C. Bokros, G. B. Engle, R. J. Price, and J. L. White 5 Oct. 1967 138 p refs
(Contract AT(04-3)-167)
(GA-7906) CFSTI: HC$3.00/MF$0.65

Results of research on the structure and properties of carbons and graphites and the effects of irradiation on these structures and properties are reported. Aspects dealt with include structure of carbonized coal-tar pitch, characterization of degree of graphitization, influence of pitch-binder content, thermal expansivity of non-graphitic carbons, radiation-induced changes in dimensions of pyrolytic carbons, annealing studies of pyrolytic carbon structures, and fission-recoil damage to carbons and graphites. Equipment and procedures used in the investigations are detailed. NSA

N68-20986# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ADVANCED GRAPHITE FUEL SYSTEMS Annual Report, 15 May 1965–14 May 1966
J. C. Bokros, G. P. Engle, W. V. Goeddel, R. J. Price, and J. L. White 1 Sep. 1967 92 p refs
(Contract AT(04-3)-167)
(GA-7100) CFSTI: HC$3.00/MF$0.65

Irradiation of molded binder-filer artifacts containing various fillers and pitch contents has been completed, and property measurements have begun. Results on dimensional changes show that these effects are temperature-dependent at 900 to 1450°C. Micrographic studies have been made on binder-filler artifacts which were molded at 120°C, baked at 500°C, and heat-treated to temperatures between 550 and 900°C. Isochronal annealing experiments have been started on carbons irradiated in capsule G9 and carbons containing Co-deposited titanium. The relation between the structure of pyrolytic carbon and its behavior under irradiation is being investigated by measuring dimensional, physical, and mechanical property changes of pyrolytic carbons. The relation between radiation-induced length changes and preferred orientation in polycrystalline graphite has been investigated by measuring the pre- and post-irradiation dimensions of samples which were cut from an extruded graphite tube and had different preferred orientations. NSA

N68-21030# Kernforschungszentrum, Karlsruhe (West Germany). Institute fuer Angewandte Reaktorphysik.
REACTOR TEMPERATURE TRANSIENTS WITH SPATIAL VARIABLES. PART 2: AXIAL ANALYSIS
L. Caldarola, W. Niedermeyr, and J. Wolt Jul. 1967 134 p refs
(EURFNR-415; KFK-618; EUR-2403)

The space-time dependent coolant heat balance equation is solved by the Laplace transform method to obtain coolant temperature transients. The lumped parameter model is used; this does not take into account heat propagation inside the fuel or heat transport along the coolant channel. Numerical examples are given. The mathematical bases of the equations used are derived. NSA

N68-21041# General Electric Co., Philadelphia, Pa.
APPLICATION OF RADIOISOTOPES FOR AEROSPACE WASTE RECLAMATION AND WATER SYSTEMS
Courtney A. Metzger (AMRL), Albert B. Hearld (AMRL), Bobby J. Reynolds (AMRL), Rufus Shivers (AEC), and Robert W. Murray Wright-Patterson AFB, Ohio AMRL Sep. 1967 17 p Proc. given at the 2d Intern. Symp. on Nucleonics, Columbus, Ohio, 12–14 Jul. 1967
(Contract AF33(615)-3308)
(AMRL-TR-67-158; AD-665457)

A life support system designed for aerospace application was thermally powered by a radioisotope heat source at a significant saving in electrical energy. This report summarizes the research program and resulting design, development, and evaluation of a vacuum distillation-vapor pyrolysis water reclamation system that was subjected to a 30-day isotope powered unmanned test. In addition to the savings of electrical energy the application of a radioisotope heat source is expected to result in a simple and more reliable water recovery system producing an excellent quality water without the use of pre- or post treatment for extended periods of operation. Discussed are other water recovery processes that show good promise for the utilization of isotopes for the thermal energy that have been subjected to comparison evaluation using electrical energy. The use of several waste management techniques to obtain a complex integrated system are discussed including urine and fecal collection, fecal storage, potable hot and cold water storage and dispensing, and potability measurements that show promise for the use of the waste heat from the isotopes. TAB

N68-21091# Atomics International, Canoga Park, Calif.
PIQUA FUEL ELEMENT EROSION ANALYSIS
R. E. Toews 31 Mar. 1967 11 p refs
(NAA-SR-MEMO-12401) CFSTI: HC$3.00/MF$0.65

The mechanism of fluid erosion and particulate erosion were evaluated; based on available data, it was concluded that the velocities in the Piqua fuel element would not create any erosion problems in the modified design. Author (NSA)

N68-21092# Atomics International, Canoga Park, Calif.
TRANSPORT-THEORY ANGULAR QUADRATURE COEFFICIENTS FOR SNAP REACTOR ANALYSIS
E. H. Ottewitte 19 Oct. 1967 21 p refs
(NAA-SR-MEMO-12592) CFSTI: HC $3.00/MF $0.65

In SNAP reactor calculations the DP sets should be used in the axial direction. Limited analysis suggests that the SN sets are as good as any in the radial direction. Also, it was found that one should include at least one more significant figure in the quadrature coefficients than is required in the results. Author (NSA)

N68-21104 Pennsylvania State Univ., University Park.
HYDROELASTIC INSTABILITIES IN FUEL PLATE ELEMENTS
George Emiel Henri Smissaert (Ph.D. Thesis) 1966 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-5970

The subject is the study of the hydroelastic instabilities that occur in nuclear-reactor flat-plate fuel elements. The particular fuel elements that were investigated consisted of flat plates, each of which is approximately 3 to 5 inches wide, 0.0625 to 0.125 inch thick, and several feet long. The plate edges parallel to the flow are rigidly clamped, and the leading edge is either free or fixed by means of a support comb. The first part is devoted to the development of the hydroelastic instability equations in two-dimensional channels bounded by flexible surfaces. The experiments indicated that flat plate fuel elements are subjected to a number of hydroelastic instabilities. The theoretical part of the thesis confirmed this observation and enabled one to identify these instabilities as: static divergence at the leading edge, static divergence in the plate array, a low-amplitude vibration in the form of traveling waves, and a high-amplitude vibration or flutter. Dissert. Abstr.

N68-21111*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POSTSHUTDOWN COOLING REQUIREMENTS OF TUNGSTEN WATER-MODERATED NUCLEAR ROCKET
Walter A. Paulson and Ray M. Crawford Washington Apr. 1968 23 p refs
(NASA-TM-X-1568) CFSTI: HC $3.00/MF $0.65 CSCL 21F

The postshutdown cooling requirements were calculated for the tungsten water-moderated reactor concept. The reactor was assumed to have operated at full power for 1 hour. An amount equivalent to 5.25 percent of the hydrogen used during the operation at full power is required to remove the energy generated after shutdown. The postshutdown cooling schedule requires continuous hydrogen flow for the first 1000 seconds followed by 23 pulsed cooling periods. The last hydrogen pulse occurs at 6.1 days after shutdown. The pulse flow rate is 0.3 pound per second (0.136 kg/sec) and the duration of the pulses range from 4250 seconds early in the schedule to 1300 seconds at later times. Author

N68-21124*# United Aircraft Corp., East Hartford, Conn.
OPTICAL ABSORPTION IN FUSED SILICA DURING TRIGA REACTOR PULSE IRRADIATION
R. Gagosz, J. Waters, F. C. Douglas, and M. A. De Crescente Washington NASA Apr. 1968 67 p refs
(Contract NASw-847)
(NASA-CR-1031; F-910485-1) CFSTI: HC $3.00/MF $0.65 CSCL 18J

An experimental investigation was conducted to determine the spectral transmission characteristics of fused silica before, during and after exposure to reactor irradiation pulses. The transmission measurements were carried out at three wavelengths (0.215, 0.625 and 1.0 microns) and at a range of temperatures from ambient to 900°C. Corning 7940 fused silica specimens in a corner cube configuration were mounted next to the reactor core face. Peak neutron and gamma fluxes obtained from this reactor were approximately 5.4×10^{15} n/cm^2-sec and 6.1×10^7 R/sec, respectively. Neutron and gamma doses associated with these pulses were 2.3×10^{14} n/cm^2 and 2.6×10^6 R, respectively. The effective time of the pulse obtained by dividing the total dose by the peak flux was approximately 0.043 sec. The transmission measurements were made immediately before, during and after the reactor pulses to monitor both the creation of irradiation induced absorption and the decay of the induced absorption after the pulse. Author

N68-21129# Oak Ridge National Lab., Tenn.
COATED PARTICLE FUELS DEVELOPMENT AT OAK RIDGE NATIONAL LABORATORY FOR PERIOD JANUARY 15, 1967 TO OCTOBER 15, 1967
J. H. Coobs, comp. and O. Sisman, comp. Dec. 1967 102 p refs Presented at the 13th AEC Coated-Particle Fuels Working Group Meeting, San Diego, Calif., 12–13 Dec. 1967
(Contract W-7405-ENG-26)
(ORNL-TM-2061; CONF-671207-1) CFSTI: HC $3.00/MF $0.65

Work is reported on optimizing fuel element design and developing fabrication methods amenable to an economical fuel cycle. Research results indicate that either carbide or oxide kernels can be used effectively in coated particles. Oxide fuel particles are produced by the sol–gel process. Testing and evaluation of coated oxides continues. A comparison of solid fission product release from coated oxide and carbide particles during irradiation and postirradiation heating continues. Various coatings were studied. NSA

N68-21143# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
DETERMINATION OF PHYSICAL REACTOR PARAMETERS FROM REACTOR NOISES, BY PROBABILITY DISTRIBUTION ANALYSIS
Dieter H. Stegemann Jan. 1967 77 p refs Sponsored by EURATOM
(KFK-542; EURFNR-285)

Use of neutron noise analyses for determination of reactor parameters is discussed. The probability distribution method is investigated. Theoretical bases for this approach are established; application to the STARK fast-thermal Argonaut reactor is detailed. NSA

N68-21150# New Mexico Univ., Albuquerque.
ANALOG MODEL OF WAVE PROPAGATION IN OPEN AND CLOSED END CYLINDER PHASE 2 OF AN INVESTIGATION OF "ANALOG STUDY OF IMPACT FRACTURE OF CLOSED-END CYLINDERS"
F. D. Ju and J. C. Wambold Apr. 1967 251 p refs Prepared for Sandia Corp.
(SC-CR-67-2627) CFSTI: HC $3.00/MF $0.65

An analog computer program is provided whereby the design engineer can get an expedient answer as to the safe impact velocity allowed with no initiation of a crack for a circular hollow cylinder, with and without an end cap. Included is a general program in which the shape parameters (wall thickness, end cap thickness, and overall diameter) are put into a digital program, the potentiometer values are calculated and with these potentiometer values set into the analog, the solution for this shape is available. A brief example of the use of this general program is also given. Author (NSA)

N68-21156 Compagnie Francaise Thomson–Houston, Paris (France).
APPLICATIONS OF THE VAPOTRON PROCESS TO BOILING WATER NUCLEAR REACTORS [APPLICATIONS DU PROCEDE VAPOTRON AUX REACTEURS NUCLEAIRES A EAU BOUILLANTE]

Brussels EURATOM 1968 99 p refs In FRENCH; ENGLISH SUMMARY
(Contracts EURATOM-001-61-6 ARF; EURATOM-050-62-5 RDC; EURATOM-034-63-11 TEEC)
(EURAEC-1890; EUR-3384.F) CFSTI: $3.00

The VAPOTRON principle uses an essentially anisothermal heat exchange surface in boiling conditions. The known VAPOTRON effect on copper occurs on low-conductivity metals such as stainless steel even at atmospheric pressure. The law of similarity of dimensions as a function of the conductivity estimated previously during similar tests was verified experimentally. The beneficial influence of the pressure was first of all verified in pool boiling up to a pressure of 70 bars; specific fluxes above 800 W/cm^2 were reached in stable conditions on elementary samples with a maximum temperature differential of 350°C between the exchange surface and the liquid. Full-scale tests in a forced convection loop consisted in designing, building and perfecting a range of special equipment, notably a system of indirect heating simulating nuclear fuel as closely as possible, a device for taking temperature measurements, a burn-out detector and visualization equipment. During the loop test program, the performance of VAPOTRON jackets was compared with that of smooth cylindrical sheaths. The set of measuring points obtained always corresponds, compared with the best known results with isothermal sheaths, to a gain which varies with the flow conditions imposed and which can reach a value of more than 2. Author

N68-21166# Argonne National Lab., Ill.
A PROTOTYPE PORTABLE PUMP AND OXIDE-CLEANUP SYSTEM FOR EBR-2 ROTATING SHIELD PLUG SEALS
P. Elias and G. Goldfuss Aug. 1967 23 p
(Contract W-31-109-ENG-38)
(ANL-7379) CFSTI: HC $3.00/MF $0.65

One of the post-shutdown operational problems existing in the EBR-II is the occasional sticking of two, motor-driven, rotating shield plugs preparatory to exchange of fuel or insertion of irradiation test specimens. Investigations indicate the cause of plug sticking is the accumulation of oxidic material in the Bi–Sn alloy rotary freeze seal on each plug. Descriptions are presented for: (1) the measures used to reduce oxidation of the seal alloy, (2) the manual techniques used periodically for batch-type removal of accumulated oxidic material, and (3) the prototype, portable pump and cleanup system designed to expedite removal of this material. Also included are the results of feasibility tests of the prototype system under simulated operating conditions. NSA

N68-21172# Los Alamos Scientific Lab., N. Mex.
CALCULATION OF THERMAL NEUTRON SCATTERING CROSS SECTIONS FOR CRYSTALLINE MATERIALS: THE TOR PROGRAM
W. W. Clendenin 18 Dec. 1967 42 p refs
(Contract W-7405-ENG-36)
(LA-3823) CFSTI: HC $3.00/MF $0.65

The FORTRAN-IV program TOR has been developed for the calculation of thermal neutron differential scattering cross sections of crystalline materials. The scattering law is calculated in the incoherent approximation of direct evaluation of the Fourier integrals. A new numerical integration technique of improved accuracy is used. This includes a verification based on the detailed balance condition for each value of the scattering law. A two-parameter function, derived from the scattering law but having more accurate interpolation properties, is provided as card output. The latter has the form of input for the FORTRAN-IV program GLEN which obtains the total scattering cross section, thermal neutron diffusion length, and flux-weighted group cross sections. Author (NSA)

N68-21188# Oak Ridge National Lab., Tenn.
IRRADIATION BEHAVIOR OF ALUMINUM-BASE DISPERSIONS CONTAINING EUROPIUM OXIDES
R. J. Beaver, A. E. Richt, and M. M. Martin Jan. 1968 51 p refs
(Contract W-7405-ENG-26)
(ORNL-4199) CFSTI: HC $3.00/MF $0.65

Three miniature control rod plates were irradiated to investigate the behavior of europium-bearing materials selected as the neutron absorber for the High Flux Isotope Reactor. The plates were irradiated at 60°C center-line temperature for periods ranging up to one year, resulting in an estimated perturbed thermal-neutron dose of up to 2.9×10^{21} neutrons/cm^2 and a fast neutron dose of up to 1.1×10^{21} neutrons/cm^2 (>1 MeV). Core volume increases were less than 0.3% in the Eu_2O_3-bearing specimens exposed to burnups of 1.6×10^{21} and 4.1×10^{21} neutron absorptions/cm^3. A slightly greater volume increase of 0.8% was observed in the $Eu_{5.3}MoO_{11}$-bearing specimen, which had absorbed 2.9×10^{21} neutrons/cm^3. No evidence of irradiation-induced microstructural changes or loss of structural integrity was observed in any of the three specimens. The type 6061 aluminum cladding hardened from approximately 50 to 100 DPH after a fast neutron SAP–UC MeV) dose of 4.9×10^{20} neutrons/cm^2. Corrosion tests in water at 100°C indicated that the Al–33 vol % Eu_2O_3 dispersions were less susceptible to hydration and swelling after irradiation than they were before. Author (NSA)

N68-21191# European Atomic Energy Community, Ispra (Italy).
THERMAL PROBLEMS INHERENT IN A FINNED ZIRCALOY CHANNEL IN AN ORGEL REACTOR [PROBLEMES THERMIQUES LIES A UN CANAL DE ZIRCALOY A AILETTES DANS UN REACTEUR ORGEL]
J. Fauré and J. Raynen Brussels Feb. 1968 44 p refs In FRENCH; ENGLISH summary
(EUR-3886.F) CFSTI: HC $3.00/MF $0.65

The feasibility of cold fins, welded to a Zircaloy coolant channel, to serve as a hydrogen sink has been studied from the thermal point of view. Temperature distributions and additional thermal losses have been determined by means of a model. This model has been verified by experiment. Author

N68-21204*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RTG INTEGRATION PROBLEM AREAS AND PARAMETRIC ANALYSIS
L. Selwitz 1 Feb. 1967 24 p
(Contract NAS7-100)
(NASA-CR-94042; JPL-TM-33-321) CFSTI: HC $3.00/MF $0.65
CSCL 10B

Current radioisotope thermoelectric generator (RTG) design concepts for space power systems are often unrealistic or incomplete from two standpoints: they generally lack understanding of, or regard for, the total mission and spacecraft requirements, and are usually unsupported by sufficient reliable data or technical information. Too little differentiation is made between proof-of-principle hardware concepts and mission applications. In the former, flights of specific RTGs or families of RTGs are planned for the purpose of determining the feasibility of new RTG sizes, weights, and fuels; in the latter the RTG has functional importance, utilized as a component whose sole purpose is to support the primary goals of the mission. Author

N68-21229# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. POST-IRRADIATION EXAMINATION OF THE SAP–UC FUEL BUNDLES OF THE NRU-305 EXPERIMENT
T. A. Golding and W. E. Krupp 1 Dec. 1967 52 p refs
Prepared in cooperation with Combustion Engineering, Inc.
(Contract AT(38-1)-430)
(AI-CE-76) CFSTI: HC $3.00/MF $0.65

The U-305 Experiment was conducted to evaluate SAP-UC and Zircaloy-UO_2 fuel systems for the HWOCR program. The U-305 was irradiated in the NRU Reactor at Chalk River, Ontario, Canada, to peak UC fuel burnup near 10,000 MWd/mtU and was removed due to defects in the Zircaloy-UO_2 portion of the experiment. The postirradiation examination of SAP-UC Bundle LTA, which experienced the highest burnup is described. Bundle LTA was disassembled and all fuel rods were subjected to visual examination, fission gas and gamma scan measurements, fouling film sampling, and profilometer measurements. Four fuel rods were destructively examined, including disassembly, visual examination of declad fuel and cladding inner surface, measurement of fuel growth and absolute burnup, and fuel and cladding metallography. No conclusive evidence of defects or radiation-induced degradation was observed in the SAP-UC. The SAP-UC fuel system demonstrated satisfactory operation at the temperature and burnup levels experienced in the U-305 Experiment. Author (NSA)

N68-21234# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Nov. 1967
Robert B. Duffield and Stephen Lawroski 28 Dec. 1967 172 p refs
(Contract W-31-109-ENG-38)
(ANL-7399) CFSTI: HC$3.00/MF$0.65

Items of significant technical progress which have occurred in both the specific reactor projects and the general engineering and research and development programs are reported. For the civilian liquid metal fast breeder reactors, attention centered on the development of metallic and carbide fuels, theoretical reactor physics experiments, sodium technology, reactor mechanisms, and fuel handling. Reactor analysis and test data are provided on the Experimental Breeder Reactor 2, and the Zero Power Reactors, along with reactor operation results. Subassemblies designs and experimental support are discussed. General reactor technology reports include cross section measurements, reactor fuels and materials, master–slave manipulator systems, engineering mechanics, and chemical separations. Nuclear safety is considered in relation to chemical and thermal energy problems, and coolant dynamics. M.G.J.

N68-21272# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
POST-IRRADIATION EXAMINATION OF CVTR FUEL ASSEMBLIES Quarterly Progress Report, Period Ending 30 Sep. 1967
M. G. Balfour, ed. Oct. 1967 36 p refs
(Contract AT(30-1)-3850)
(WCAP-3850-1) CFSTI: HC$3.00/MF$0.65

Six CVTR fuel assemblies were received for post-irradiation examination. Special assembly G-2 (undefected) was examined by underwater periscope; the fuel rods were removed from special assembly G-1 and rod #24.732 (25.1 kW/ft. design) was observed to have broken into two sections approximately 13 inches from its lower end. It was examined thoroughly underwater. This and the remaining fuel rods from G-1 were transferred to the hot cells for further non-destructive examinations, including leak testing, profilometry, and stereomicroscopic examination. Rod removal from special assemblies G-3 and G-4 in the pool was unsuccessful, necessitating transfer and disassembly in the hot cells. Standard CVTR assemblies 502-1-18 and 502-2-31 were disassembled in the hot cells. Leak testing identified corner peripheral fuel rods #1475 and #1549, respectively, as the defected rods from these assemblies. Fuel rod #1475 was defected near the upper end plug weld, with an annular strip of cladding broken away at this point. Fuel rod #1549 contained two large (approximately 150 mils) holes in the cladding within the lower 10 inches of the rod. The defected rods and sister rods (i.e., those selected for destructive examination in addition to the defected rods) from the standard assemblies exhibited extremely heavy deposits of crud, locally exceeding 10 mils thickness. Crud mapping and sampling were included in the non-destructive examinations together with gamma scanning, profilometry, and stereomicroscopic examination. Author (NSA)

N68-21325# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
DIGITAL CORRELATION ANALYSIS OF OSCILLATION MEASUREMENTS
T. Ferrari, R. Martinelli, A. Musco, and E. Santandrea 1967 26 p refs
(RT/FI(67)26) CFSTI: HC$3.00/MF$0.65

The input–output crosscorrelation technique has been applied to analyze the response of the RANA reactor to power modulation due to oscillation of absorbing samples. The method and electronic equipment used are described; some preliminary results obtained in effective cross section and spectral index measurements are reported. Author

N68-21335# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum Seibersdorf.
ARTIFICIAL MATERIALS AND NUCLEAR TECHNOLOGY [KUNSTSTOFFE UND KERNTECHNIK]
E. Proksch 1968 22 p refs In GERMAN Presented at the Comm. for Study of Artificial Mater. Technol., Vienna, 14 Dec. 1967 Submitted for publication
(SGAE-CH-50/1968) CFSTI: HC$3.00/MF$0.65

This summary points out some of the unique requirements associated with the use of synthetic materials in nuclear technology and considers the application of radiological and radiochemical methods in the production and processing of synthetics. Briefly discussed are decontamination methods, radiation resistance, use of radioactive isotopes, tracer methods, absorption and backscattering, activation analysis, and radiochemical polymerization. Transl. by K.W.

N68-21386# Oak Ridge National Lab., Tenn.
HEAVY SECTION STEEL TECHNOLOGY PROGRAM Semiannual Progress Report, Period Ending 31 Aug. 1967
Jan. 1968 85 p refs
(Contract W-7405-ENG-26)
(ORNL-4176) CFSTI: HC$3.00/MF$0.65

The Heavy-Section Steel Technology Program for the investigation of the structural behavior of thick light-water cooled nuclear reactor pressure vessels is described. First, engineering methods in current use on thinner vessels will be evaluated for their applicability to thicker vessels. Then, a thorough mechanical properties testing program will be undertaken which will include full sized vessel tests as well as tests of steel plates. Ultrasonic inspection of program plates, before and after heat treatment, has already been done. Plate specimens for testing have been fabricated. Two research programs to investigate the effects of irradiation on fracture toughness of thick pressure vessel plates are underway. Planned activities for determining actual pressure vessel behavior are outlined. NSA

N68-21386# Oak Ridge National Lab., Tenn.
SPECIAL SOURCES OF INFORMATION ON ISOTOPES
F. E. McKinney, R. H. Lafferty, Jr., and P. S. Baker Jan. 1968 136 p refs *Its* 4th Rev.
(Contract W-7405-ENG-26)
(ORNL-IIC-12; TID-4563) CFSTI: HC$3.00/MF$0.65

A comprehensive guide to information and services related to isotopes is presented. Isotopes and their uses are described as background for those not familiar with the subject. The availability of references is given, as well as addresses of publishers. 831 separate sources of information including published literature, films, libraries, and information centers for all phases of isotope technology are listed. NSA

N68-21402*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NERVA PROGRAM STATUS
Robert W. Schroeder 10 Apr. 1968 25 p Presented at 5th Symp. on Advan. Propulsion Concepts, Chicago, 10 Apr. 1968
(NASA-TM-X-60977) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Origin and major activities are described for the NERVA program, which presently encompasses both technology and engine programs. Reactor design and development is discussed; as are the interactions among reactor, nozzle, turbopump, and control system during integrated testing. Attention is also given to basic and safety factors. Fabrication efforts are also involved, including the means to mass produce fuel elements with consistent characteristics at reasonable costs and with reasonable yield ratios. Major efforts have also been applied toward producing regeneratively-cooled nozzles with large numbers of thin-walled coolant tubes that have reproducible characteristics and are consistently sound bonding. A section on reactor development is devoted to full scale reactor testing of graphite reactors. Chamber temperatures of more than 4000°C have been demonstrated. M.W.R.

N68-21458# Institutt for Atomenergi, Kjeller (Norway).
MODEL FOR THE DYNAMICS OF NUCLEAR REACTORS WITH BOILING COOLANT WITH A NEW APPROACH TO THE VAPOUR GENERATING PROCESS
P. Bakstad and K. O. Solberg Aug. 1967 79 p refs
(KR-121)

A dynamic model is described which can be used for steady state, stability and transient analysis of boiling channels and nuclear reactors with a boiling coolant. Based upon a certain physical model for the vapor generating process, wherein the lack of thermal equilibrium between the vapor and fluid phases is a fundamental assumption, a general description of the hydraulics is derived. This description permits the direct determination of the vapor content in the various parts of the hydraulic loop: in the subcooled and bulk boiling regions, in the riser and downcomer parts. No explicit calculations of boiling boundaries from empirical relationships are necessary. Fluid flashing and vapor condensation, due to pressure changing with time, are inherently taken care of. Further vapor carry-under in the downcomer and reversal of the flow in some part of the loop can easily be accounted for. Some comparisons with experimental loop results are shown, for steady state conditions and for the hydraulic stability limits. Further examples of applications of the model to reactor dynamics analysis are given, which demonstrate the importance of thermal "non-equilibrium." The model, which represents a new approach rather than a final result, points out that basic problems in two-phase dynamics are still to be solved. Author (NSA)

N68-21459# Junta de Energia Nuclear, Madrid (Spain). Division de Fisica.
METHODS FOR NUCLEAR REACTOR CALCULATIONS [METODOS DE CALCULO EN REACTORES NUCLEARES]
G. Velarde 1966 24 p In SPANISH
(JEN-171-DF/I-51)

Methods for solving the neutron transport equation in reactors are determined. The mathematical techniques utilized are P_L, B_L, M_L, S_N and discrete ordinate approximations. Simplifications and assumptions are outlined. NSA

N68-21631# European Atomic Energy Community, Brussels (Belgium).
AN UNSOLVED PROBLEM IN METALLURGY: STRESS RELIEF ANNEALING OF NUCLEAR REACTOR VESSELS [UN PROBLEME METALLURGIQUE NON RESOLU: LE RECUIT DE DETENTE DES CUVES POUR REACTEURS NUCLEAIRES]
J. Sebille 8 Dec. 1966 23 p refs Presented at Conf. on Experts on Recurring Inspection of Nucl. Reactor Pressure Vessels, Pilsen, Czech., 3–7 Oct. 1966 Sponsored by EURATOM
(EURAEC-1762; EUR-3317; CONF-661047-1)

The metallurgical aspects of stress-relief annealing requires supplementary research, the results of which demonstrate both its advisability and importance from the standpoint of vessel properties and safety. Author (NSA)

N68-21705*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HOT ISOSTATIC COMPACTION OF TUNGSTEN–URANIUM DIOXIDE FUELS WITH HIGH-VOLUME FRACTION OF URANIUM DIOXIDE
Paul F. Sikora and Andrew C. Millunzi Washington Apr. 1968 19 p refs
(NASA-TM-X-1563) CFSTI: HC $3.00/MF $0.65 CSCL 18J

Dense (>98 percent of theoretical) tungsten–uranium dioxide cermets containing 30 to 70 volume percent uranium dioxide were fabricated by hot isostatic compaction of tungsten-coated uranium dioxide particles. Both thin plates (0.020-in. or 0.051-cm thick) and small-diameter rods (0.20-in. or 0.51-cm diam) were successfully produced at compaction conditions of 3100°F (1700°C) and 30,000 psi (207 MN/m^2). In addition to volume-fraction loading of uranium dioxide, other variables studied in this program were the effect of (a) fuel particle size in the range of 50- to 110-micron diameter, (b) molybdenum or a molybdenum alloy (TZM) in container assemblies, and (c) compaction schedule and pressure (up to 42,000 psi or 295 MN/m^2). Fully dense cermets were produced with all combinations of the range of variables studied. The surface smoothness of the cermets was affected only by the choice of container materials. Containers produced from TZM resulted in smooth cermet surfaces; however, unalloyed molybdenum containers often resulted in irregular surfaces. The feasibility of applying a thin tungsten cladding to the cermet surfaces as an integral part of the compaction process was also demonstrated. Author

N68-21803# Martin Co., Baltimore, Md. Nuclear Div.
SNAP 19 RADIATION MEASUREMENTS REPORT Final Report
H. B. Rosenthal, W. D. Owings, and J. M. Hrubovcak Nov. 1967 99 p refs
(Contract AT(30-1)-3607)
(MND-3607-173) CFSTI: HC $3.00/MF $0.65

The techniques used in determining the energy distribution and absolute magnitude of the neutron and gamma radiation emitted from all SNAP 19 fuel capsules and assembled generator subsystems are described. The electronics, calibration, and operation of the neutron spectrometer are discussed along with preliminary measurements performed to evaluate the system response. Neutron and gamma spectra and dose rate measurements are tabulated. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-20590# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE ACOUSTIC ENVIRONMENT PREDICTED FROM A 50-TON HIGH EXPLOSIVE
Andrew A. Thompson and George L. Soscia Dec. 1967 34 p refs
(BRL-TN-1674; AD-665630)

The technical note discusses the possibility of detecting at Fort Huachuca a 50-ton surface explosion at White Sands in

the month of June. Through the application of ray tracing and semiempirical relations it is shown that a low amplitude signal may be detected in June if the ambient noise conditions at the station were low. Slight departures from the 5-year meteorological averages could allow stronger signals to be recorded at the station.
Author (TAB)

N68-20612 Ohio State Univ., Columbus.
MAGNETIC PROPERTIES OF DILUTE LIQUID He^3–He^4 SOLUTIONS
Donald Le Roy Husa (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-6325

The nuclear magnetic susceptibility and diffusion coefficient have been measured for dilute liquid He^3–He^4 solutions. The susceptibility measurements were made on 2% to 15% solutions over the range 0.35°K to 2°K. The susceptibility was found to be very close to the ideal Fermi–Dirac form indicating that the effective interactions between the He^3 particles are very small. The diffusion coefficient was measured for 2% and 12% solutions from 0.4°K to 1.2°K. The diffusion coefficient was found to be inversely proportional to concentration and temperature in the range 0.4°K to 0.7°K in agreement with earlier work. The diffusion measurements were characterized by anomalously small spin-spin relaxation times in agreement with the results of other workers. The origin of this small spin–spin relaxation time, T_2, is not known. The spin-lattice relaxation time, T_1, was found to be dependent on relaxation at the walls of the sample container. Dissert. Abstr.

N68-20620# Illinois Univ., Urbana. Antenna Lab.
DIFFRACTION BY A THICK CONDUCTING HALF-PLANE AND A DIELECTRIC-LOADED WAVEGUIDE
S. W. Lee and R. Mittra Dec. 1967 39 p refs *Its* Antenna Lab. Rept.-67-8
(Contract AF 19(628)-3819)
(AFCRL-68-0015; TR-13; AD-665879)

The paper investigates the problem of diffraction of an incident plane wave by a half-plane with a finite thickness. The generalized scattering matrix procedure, which has been found useful for attacking waveguide discontinuity problems, is shown to apply to open region problems as well. Based on this procedure, a highly convergent Neumann Series solution is derived and numerical calculations are presented for a wide range of parameters. The method of solution is not restricted to sufficiently thin half-planes only as is the one discussed by Jones. Comparisons with Jones results show good agreement in the range where his results are valid. New results are presented for the extended range of thickness of the half-plane. Two other related problems, viz., those of radiation from a waveguide loaded with a dielectric or plasma medium, and diffraction by an inhomogeneously loaded waveguide, are also investigated in this paper. Author (TAB)

N68-20640# Michigan Univ., Ann Arbor. Radiation Lab.
INVERSE SCATTERING INVESTIGATION Quarterly Report, 3 Jul.–3 Oct. 1967
Vaughan H. Weston, Wolfgang M. Boerner, and Charles L. Dolph Bedford, Mass. Electron. Systems Div. Nov. 1967 87 p refs
(Contract F19628-67-C-0190)
(Rept.-8579-3-Q; ESD-TR-67-517, V. 3; QR-3; AD-665857)

The problem in question consists of determining means of solving the inverse scattering problem where the transmitted field is given and the received fields are measured, and this data is used to discover the nature of the target. Particular aspects of this overall problem are considered, such as the effect of phase errors upon the determination of the scattering surface, polynomial interpolation of the scattered field measured at a set of discrete points, and the testing of a numerical procedure for finding the surface of a conducting body from the knowledge of the near field. In addition, a review of exact theoretical treatments for the scalar inverse problem is given. Author (TAB)

N68-20654# Wisconsin Univ., Madison. Mathematics Research Center.
SPECTRAL AND SCATTERING THEORY FOR MAXWELL'S EQUATIONS IN AN EXTERIOR DOMAIN
G. Schmidt Aug. 1967 86 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-770; AD-665345)

The spectral theory and the scattering theory of Maxwells equations in the exterior of an obstacle are studied using the techniques developed by Phillips and Lax in their book Scattering Theory. Author (TAB)

N68-20677 North Carolina State Coll., Raleigh.
THE DERIVATION OF THE SURFACE IMPEDANCE MATRIX OF A CURVED SURFACE AND THE INTERNAL IMPEDANCE OF A FINITE CONDUCTING CYLINDER BY USE OF THE ELECTROMAGNETIC HUYGEN'S PRINCIPLE
David Irving Fairbanks (Ph.D. Thesis) 1966 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-5676

The surface impedance matrix of (1) a finite flat surface, (2) a good conducting finite curved surface with a large principal radius of curvature, and (3) the internal impedance of a finite good conducting cylinder are derived. The approach was by use of an electromagnetic Huygens' Principle. The results obtained not only agree with less rigorously derived results from the literature but extend the expressions to higher order terms hitherto unobtainable. The surface impedance matrix is shown to be a fundamental property of the material and the geometry of the surface. Dissert. Abstr.

N68-20711# IIT Research Inst., Chicago, Ill.
FIBER OPTICS WITH EXTENDED ULTRAVIOLET TRANSMISSION Triannual Report, No. 1, 1 Jul.–31 Oct. 1967
P. C. Li, H. Olson, D. A. Pontarelli, and M. A. Schwartz Feb. 1968 69 p refs
(Contract DAAB07-67-C-0542)
(G6018; ECOM-0542-1; AD-665410)

The objective of this contract is to conduct a research and development program leading to the fabrication of fiber-optic faceplates for cathode ray tubes with high transmission in the near- and medium-ultraviolet spectral regions. The first years study is primarily to evaluate existing optical glasses (Phase I) and develop improved ones suitable for meeting the specific performance requirements of the contract (Phase II). Known commercial optical glasses having desirable properties, particularly in transmission, softening point, and refractive index, were initially screened. Author (TAB)

N68-20865# Sylvania Electric Products, Inc., Mountain View, Calif.
SCATTERING BY PENETRABLE SPHEROIDS
James E. Burke Feb. 1968 24 p refs
(Contract DAAB07-67-C-0181)
(EDL-M1050; ECOM-0181-M1050; AD-665401)

The exact spheroidal-function series solution for the scattering of a plane wave by a penetrable spheroid is used to obtain explicit low-frequency (long-wavelength) approximations in ascending powers of k = 2 pi/lambda where lambda is the wavelength. The farfield scattering amplitude is given to the sixth power of k, and the fields near and inside the spheroid are given to the second and first power, respectively. The results are valid for prolate and oblate spheroids and arbitrary angles of incidence and observation. Author (TAB)

N68-20873# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
STUDY AND TESTS TO REDUCE COMPRESSOR SOUNDS OF JET AIRCRAFT

E. B. Smith, M. J. Benzakein, and K. P. Radecki Feb. 1968 536 p refs
(Contract FA-65-WA-1236)
(DS-68-7)

Two methods of reducing jet engine compressor noise have been demonstrated: "partial choking" in the IGV, and application of acoustic materials to vanes, struts and duct walls. Unique facilities for evaluation of acoustic material performance in jet engines are described and results of an extensive measurements program are presented. Author

N68-20902 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF METHOD OF SMALL PARAMETER TO ANALYSIS OF HYPERSONIC FLOW OF GAS AROUND FLAT BODIES [PRIMENENIYE METODA MALOGO PARAMETRA K RASCHETU OBTEKANIYA PLOSKIKH TEL GIPERZVUKOVYM POTOKOM GAZA]
A. M. Antonov and A. G. Stetsenko *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 1–10 refs (See N68-20901 11-19)

An approximate method is presented on calculating the flow of a hypersonic stream of ideal gas past thin bodies, in the case when the form of the shock wave is assumed to be given. This method is based on the expansion of all the unknown functions in power series in terms of a small parameter τ which characterizes the relative dimensions of the body (the thickness or the angle of inclination of the body to the incident flow). Differential equations are written down and also the corresponding boundary conditions for the determination of the current function ψ in the first and second approximations with respect to τ. In both approximations the equations are nonlinear. Author

N68-20903 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF HYSTERESIS MOTOR ON STABILITY OF MOTION OF GYROSCOPE IN CARDAN JOINT SUSPENSION [VLIYANIYE GISTEREZISNOGO MOTORA NA USTOYCHIVOST' DVIZHENIYA GIROSKOPA V KARDANOVOM PODVESE]
R. M. Borodina *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 11–19 refs (See N68-20901 11-19)

Asymptotic methods are used to solve the problem of the motion of a gyroscope in a Cardan suspension with a low-power electrical drive. After reduction of the equation of motion to standard form in the case when the moment of the axis of natural rotation of the rotor is proportional to a small parameter, the averaged equations of the first approximation are integrated. The results show that the amplitude of the oscillations is constant, the angular velocity of drift of the gyroscope coincides with the angular velocity of drift in a free gyroscope, and the angular velocity of the natural rotation is stabilized by the motor, and, on the average, remains constant. Author

N68-20905 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF STABILITY OF MOTION IN ONE CASE OF THE THREE BODIES [K VOPROSU OB USTOYCHIVOSTI DVIZHENIYA V ODNOM SLUCHAYE ZADACHI O TREKH TELAKH]
M. M. Zatenyakin *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 31–37 refs (See N68-20901 11-19)

For the case of attraction inversely proportional to the distance squared, the stability of an almost circular Lagrange motion is investigated. Author

N68-20907 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE INFLUENCE OF RANDOM FORCES ON NONLINEAR OSCILLATORY SYSTEMS [O VOZDEYSTVII SLUCHAYNYKH SIL NA NELINEYNYYE KOLEBATEL'NYYE SISTEMY]
V. G. Kolomiyets *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 49–56 refs (See N68-20901 11-19)

It is assumed that the behavior of a dynamic system is described by a system of ordinary differential equations which are written in vector form. For the statistical processes, the equations of Einstein, Fokker–Planck, and Kolmogorov (EFPK) are used for probabilities of transition and frequency distribution functions. The EFPK equations are applied only for Markov processes; therefore, in the equations considered, random forces possess delta correlation. It is proved that in the absence of static variance, amplitude bends to two with the greatest probability. For density of phase distribution, a normal law is obtained since the Fokker–Planck equation becomes a standard diffusion equation. Variance of phase gain of natural oscillations increases without limit in time. It is shown that in autonomous systems, there is no steady state regime for phase fluctuations. Author

N68-20911 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RANDOM SHOCKS IN LINEAR DYNAMIC SYSTEMS [SLUCHAYNYYE TOLCHKI V LINEYNYKH DINAMICHESKIKH SISTEMAKH]
V. D. Mil'man and A. D. Myshkis *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 79–100 refs (See N68-20901 11-19)

Consideration is given to the probability law of the trajectory behavior of a system. It is assumed that solutions to the vector–matrix formulation of the linear dynamic system are asymptotically stable, and that the shocks occur infrequently although their amplitudes, in general, are not small. Author

N68-20927# Bettis Atomic Power Lab., Pittsburgh, Pa.
SOME EXPERIMENTAL TECHNIQUES USED IN REACTOR HEAT TRANSFER AND FLUID FLOW RESEARCH
S. J. Green, ed. Nov. 1967 223 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-386) CFSTI: HC $3.00/MF $0.65

Experimental techniques used in obtaining heat transfer and fluid flow data are described. The principal objective of the experiments was to obtain information that describes rather than explains the particular phenomenon being investigated. Thus, a description of studies that are macroscopic rather than microscopic in nature are provided. Author (NSA)

N68-20987# Tennessee Univ., Knoxville. Ultrasonics Lab.
REFLECTION AND SUBSEQUENT PROPAGATION OF A FINITE AMPLITUDE ULTRASONIC WAVE
Arnie Lee Van Buren Dec. 1967 141 p refs
(Contract Nonr-4289(01))
(TR-4; AD-665786)

When an ultrasonic wave is reflected from an interface, a phase shift which is dependent on the angle of incidence occurs. If the wave is of finite amplitude, this phase shift causes relative spatial shifting of the Fourier harmonic components. A model which assumes independent reflection of the Fourier components is used to determine the resulting unstable wave shape. The phase shift upon reflection of a specific Fourier component is derived from linear theory. The phases and amplitudes of the resynthesized components are calculated for different distances of propagation of the wave after reflection. An experimental technique is developed to measure the amplitudes and phases of the first two Fourier

components in the reflected wave. The results of these measurements are found to be in good agreement with the theoretical results. Author (TAB)

N68-21037*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
PLASMA ENGINEERING
Solomon Pollack, George Schrenk, Samuel Schweitzer, and Hsuan Yeh *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Dec. 1967 5 p (See N68-21035 11-03)

A study is being made of the operation parameters and the flow in an electromagnetically driven mercury centrifuge or mercury rotor gyro. During this period it became apparent that because the electrode material is not perfectly conducting, certain idealizations are not valid. The problem of the completely static region, consisting of the inner electrode, fluid, and outer electrode, was solved with finitely conducting electrodes. Corresponding potential measurements were made around the electrodes and in the fluid. Secondary flow induced by current passing through the device is under study. Another investigation is being made of the high field effects on surface charge distributions on an atomic scale. A quantum mechanical model of the tunneling process was constructed during this period and numerical results are being obtained for platinum. A study was begun on the effects of the basic materials properties of silicon solar cells on their initial and long term performance. R.N.A.

N68-21102 Arizona State Univ., Tempe.
STABILITY OF MOTION OF A SPINNING RIGID BODY SUBJECTED TO PERIODIC DISTURBANCES
Frank Blakeslee Wallace, Jr. (Ph.D. Thesis) 1967 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-3209

The purpose is to develop techniques to investigate stability in entire regions of the parameter space. Three separate methods of analysis are employed. The first technique consists of an adaptation of the Liapounov second or direct method of analysis into a form that is suitable for use with the periodic systems. The difference between the Hamiltonian function and the Hamiltonian function evaluated at an equilibrium position is shown to be a suitable testing function for use with the stability theorem. This method is used to describe one type of instability boundary and to show the approximate locations of the resonant instability regions. A second method of analysis is developed for describing the regions of parametric resonance of multi-degree-of-freedom, linear, periodic systems of the type encountered in rigid body dynamics problems. A third method of analysis is employed in which an asymptotic expansion of the equations of motion in terms of a small parameter is applied to the multi-degree-of-freedom periodic systems. Dissert. Abstr.

N68-21162# Atomic Weapons Research Establishment, Aldermaston (England).
THEORETICAL AND EXPERIMENTAL FIELD LIMITATIONS IN CYLINDRICAL FLUX COMPRESSION EXPERIMENTS
C. S. Speight Dec. 1967 23 p refs
(AWRE-O-71/67) CFSTI: HC $3.00/MF $0.65

The explosively driven cylindrical imploder has been used in many laboratories to produce very high magnetic fields. Fields of about 5 MG have frequently been obtained by this technique and, in some instances, fields much greater than this have been reported. A simple theoretical analysis is presented which indicates the limitations in field arising from the mechanical and electrical properties of the imploding liner. Author (NSA)

N68-21215# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugmechanik.
ON THE PROBABILITY DISTRIBUTION OF A CLASS OF ESTIMATORS FOR THE MATRIX OF POWER DENSITY FUNCTIONS OF A GAUSSIAN MULTIDIMENSIONAL STATIONARY RANDOM PROCESS [UEBER DIE WAHRSCHEINLICHKEITSVERTEILUNG EINER KLASSE VON SCHAETZFUNKTIONEN FUER DIE SPEKTRALDICHTEN-MATRIX EINES STATIONAEREN MEHRDIMENSIONALEN ZUFALLSPROZESSES]
Alexis von Baranoff Dec. 1967 78 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-89) CFSTI: $3.00

A class of estimators for the power density functions of a Gaussian multidimensional stationary random process, based on a finite discrete-time-sample is introduced, and it is proved that under the assumption of a sufficiently large sample the estimators possess a joint normal distribution, provided that the stationary process satisfies certain additional conditions. Finally, it is suggested that the Maximum Likelihood Principle could provide a smoothing procedure to be applied to the originally obtained results of estimation. Author

N68-21269# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ELECTRICAL PROPERTIES OF THERMOELECTRIC LEGS—STATISTICAL CORRELATION STUDIES
Jonathan Black (M.S. Thesis—Pa. State Univ.) Nov. 1967 79 p refs
(Rept.-67SD336)

Thermoelectric materials are widely used in space power systems to convert heat energy to electricity. The SNAP-27 Program is directed towards providing a power supply for lunar surface application and uses two such materials, lead telluride and lead tin telluride. During this program, a requirement evolved for a specification for these thermoelectric materials for long life application. A SNAP-27 sub-task program, TELPS (Thermoelectric Leg Product Specification), was designed and conducted by the author to provide the data on materials required to prepare a specification. This paper summarizes that program and in particular deals with a comparison of electrical measurements gathered during pre-TELPS quality control procedures and electrical measurements made by techniques developed during the TELPS program. Conclusions are drawn concerning the statistical confidence involved in such comparisons. Author

N68-21291*# Pennsylvania State Univ., University Park. Dept. of Astronomy.
A REPORT OF THE TESTS PERFORMED ON THE ZEISS H α FILTER
Donald F. Neidig, Jr. 8 Mar. 1968 23 p refs
(Grant NGR-39-009-066)
(NASA-CR-94087) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Tests were made on the Zeiss Hα filter to determine its optical characteristics. It was found that the 1/4 Å bandpass was slightly narrower than stated, while the 1/2 Å bandpass was actually wider and squared off at the top of the profile. Wavelength of transmission was found to be accurate to within smaller limits than the bandpass of the transmittance so that tuning is accurate. At filter settings of Hα $\pm$ .015 Å, both desired and secondary responses are comparable in intensity; although the ratio of the intensity of the secondary to desired response becomes objectionably large for filter settings beyond about Hα $\pm$ 8 Å. M.W.R.

N68-21311# International Consultant Scientists Corp., Brookline, Mass.
GRAVITATION. ON THE MASS ENERGY RELATION TO GRAVITATION [GRAVITATION. SUR LA RELATION MASSE-ENERGIE EN GRAVITATION]
25 Mar. 1968 4 p ref Submitted for publication
(Contract N00014-66-C0217)

A method of successive approximations is used to examine the structure of a nonlinear equation on the relation of mass and energy to gravitation. A magnetic charge is introduced, the inclusion

of which has the effect of doubling the mass distributed in the field. Examples are given to show the applications of this nonlinear gravitation theory to atmospheric electricity phenomena.
Transl. by M.G.J.

N68-21362# California Univ., Los Angeles. Dept. of Mathematics.
ON A NONLINEAR VIBRATING STRING
Gary D. Johnson (Ph.D. Thesis) 1967 129 p refs
(Contract Nonr-233(76))
(Rept.-67-6; AD-665984)

A nonlinear vibrating string equation is obtained from a careful derivation of the (linear) wave equation. The problem is shown to be not well-posed by construction of arbitrarily smooth initial data such that a singularity in the solution is produced, say at time t = T sub b. A result from the theory of monotone operators is used to obtain a lower bound of T sub b for a large class of initial data. Author (TAB)

N68-21373# Commissariat a l'Energie Atomic, Saclay (France). Departement du Synchrotron Saturne.
CALCULATION OF POLE PROFILES FOR DESIGN OF PARTICLE ACCELERATOR MAGNETS. EQUIVALENT CURRENTS AND CONFORMAL REPRESENTATIONS METHODS [CALCUL DE PROFILS POLAIRES DESTINES A DES AIMANTS D'ACCELERATEURS DE PARTICULES. METHODE DES COURANTS ET METHODE DES TRANSFORMATIONS CONFORMES]
Salah Jaidane (Ph.D. Thesis—Paris Univ., Orsay (France)) May 1967 151 p refs In FRENCH
(CEA-R-3238) Available from Doc. Franc., Secretar. Gen. du Gouvt., Direc. de la Doc., 31, quai Voltaire, Paris VIIeme

Two methods allow the determination of the shape of the poles in magnets, for a given field distribution in the air-gap. The principle of the first method is based on creating the desired field by means of current sheets in which one can adjust the density given in a polynomial form. For the right distribution of these currents, the equipotential corresponding to the magnetic potential of the excitation coils is calculated. The pole profile of the H or C magnet identified with this equipotential line will finally take the place of the distribution of the current sheets used in the calculation. Steel permeability is assumed to be infinite and Foucault current effects are neglected in the case variable fields. The second method is based on finding a conformal representation that maps the pole profile plane upon the upper half of another plane where the equipotentials are two half straight lines, and where the field problems are easier to solve. Steel permeability is again considered to be infinite and the coils far from the pole faces. Author (NSA)

N68-21444*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
ELECTROMAGNETISM IN MOVING, CONDUCTING MEDIA
Rudolph M. Kalafus (Ph.D. Thesis) Washington NASA Apr. 1968 95 p refs
(Grant NGR-23-005-107)
(NASA-CR-1025; Rept.-7322-3-T) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Based on Minkowski's theory of the electrodynamics of moving bodies, the present work is concerned with the systematic solution of problems involving sources placed in a uniformly moving, conducting medium. In order to accomplish this it is first necessary to examine the two differing forms of Ohm's law for moving media that are found in the literature. It is concluded here that the two forms are equivalent and interchangeable, and that their apparent difference arises out of different definitions of conduction and convection currents. Another difficulty which is encountered when dealing with conducting media is related to the relaxation phenomenon. The total charge and current densities cannot be independently specified, but must be consistent with the relaxation phenomenon; for non-conducting media only the equation of continuity must be met. A scheme is developed here which involves a separation of currents and charges into source and response terms. The source terms can be specified independently, but the total charge must be consistent with Maxwell's equations. Vector and scalar potentials are developed from the field quantities, and partial differential equations for the potentials are derived for two classes of problems: static charge sources, and harmonic current sources. For unbounded regions potential solutions are found by the method of Green's functions, which satisfy the same differential equations. The differential equations are solved by transform methods, and the Green's functions are found in closed form. The medium is assumed to have constant scalar parameters of permittivity, permeability, and conductivity. The results are valid for all values of conductivity and frequency, and for relativistic velocities.
Author

N68-21450# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
INFLUENCE OF THE MAGNETIC FIELD PERTURBATIONS OF THE PARTICLE FOCUSING IN QUADRUPOLE LENSES [VLIYANIE VOZMUSHCHENII MAGNITNOGO POLYA V KVADRUPOL'NYKH LINZAKH NA FOKUSIROVKU CHASTITS]
V. P. Kartashev, V. I. Kotov, and R. A. Rzaev 1967 10 p refs In RUSSIAN
(IFVE-OP-67-22-K)

Nonlinear aberrations caused by distortions of the magnetic field in qaudrupole lenses are considered. Aberration graphical expressions for a quadrupole doublet focusing a parallel beam to a point stigmatically are presented. Author (NSA)

N68-21453# Paris Univ., Orsay (France). Institut de Physique Nucleaire.
RENORMALIZATION AND THE CLASSICAL ELECTROMAGNETIC ONE-BODY PROBLEM FOR AN EXTENDED BODY
E. Arnous, J. Madore, and A. Papapetrou Jun. 1967 9 p refs
(IPNO/TH-92)

A decomposition of the Maxwell stress–energy tensor into two terms is proposed corresponding to the decomposition of the electromagnetic force into radiative and nonradiative parts given by Dirac. This permits the nonradiative force to be expressed as the divergence of a nonradiative tensor. This tensor is added to the matter tensor to form the total or renormalized matter tensor.
Author (NSA)

N68-21518# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SPECTRAL LINE INTERFEROMETRY AND INTERFEROMETER NOISE ANALYSIS
Alan E. E. Rogers 16 Jan. 1968 28 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-595; TR-441; AD-666038)

The theory of spectral line interferometry is developed with special reference to interferometer systems built to study the emission from interstellar OH molecules. Expressions for the root-mean-square noise of visibility amplitude and phase are derived in terms of the geometric means of the system and antenna temperatures. Methods are discussed for obtaining the visibility function from measurements made at widely separated sites by means of precise frequency and time standards. Author (TAB)

N68-21546# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRODE-ADJACENT LAYERS ON "HOT" ELECTRODES [O PRIELEKTRODNYKH SLOYAKH NA "GORYACHIKH" ELEKTRODAKH]
G. A. Lyubimov 20 Sep. 1967 19 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1965 p 45–53
(FTD-MT-24-276-67; AD-666151)

On the basis of analysis of solutions of model problems on the electrode-adjacent layer, both on ion absorbing and ion reflecting surfaces, an attempt is made to formulate a semiempirical theory of the electrode-adjacent layer. For certain cases, comparison is made of experimental data with calculated data, and, in particular, experimental constants necessary for formulation of theory are determined. Author (TAB)

N68-21549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON STABILITY OF MOTION WITH CONSTANTLY ACTING PERTURBATIONS [OB USTOYCHIVOSTI DVIZHENIYA PRI POSTOYANNO DEYSTVUYUSHCHIKH VOZMUSHCHENIYAKH]

A. A. Tikhonov 24 Aug. 1967 25 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 1, 1965 p 95–101
(FTD-MT-24-168-67; AD-666086)

An analysis is made of the effect of constantly acting perturbations upon the motion of a body described by a system of differential equations of the form the derivative of X sub s with respect to t = summation from k = 1 to k = n of the quantity ((p sub (sk) X sub k) + X sub s (X sub 1, X sub 2,..., X sub n) + f sub s (t,X sub 1,...,X sub n)), where P sub sk are constant real coefficients, X sub s are functions which can be expanded in an absolutely convergent series in integer powers of x in the neighborhood of the origin of a phase space, and f sub s are functions representing constant perturbations which satisfy the inequality the absolute value of (f sub s (t,X sub 1, X sub 2,..., X sub n)) < f star sub s(t) where f star sub s are certain continuous functions. TAB

N68-21563# University of Southern Calif., Los Angeles. Electronic Sciences Lab.

CONSOLIDATED SEMIANNUAL PROGRESS REPORT, 1 APRIL–30 SEPTEMBER 1967

30 Sep. 1967 274 p refs
(Grants AF-AFOSR-68-1405; AF-AFOSR-76-66; AF-AFOSR-188-67; AF-AFOSR-496-67; AF-AFOSR-874-67 et al)
(SAPR-6; AD-666451)

Contents: Solid state - Semiconductors; Quantum electronics and lasers; Magnetism; Defects in crystals; High field superconductivity; Metals; Applied electromagnetics and plasmas - Plasmas; Information sciences - Control systems; Communication systems; Switching and automata theory; Biomedical engineering - Manual control systems; Neuromuscular systems; Cardiovascular and respiratory systems; Artificial kidneys. TAB

N68-21567# Navy Underwater Sound Lab., New London, Conn.

TRANSIENT REFLECTIONS OF SOUND FROM MULTILAYERED FLUID-SOLID MEDIA

Leonard E. Mellberg 31 Jan. 1968 22 p refs
(USL-860; AD-666111)

The theory of the transient pressure field produced by the reflection of sound waves from multilayered fluid-solid media is developed. The sound originates at a line or point impulsive source in a two-dimensional semi-infinite fluid. An expression for the transient reflected pressure field is derived in terms of a double Fourier inversion integral over all the frequencies and horizontal components of all the wave numbers. The specific forms of the integrand within the inversion integral are presented for various types of pulses. Author (TAB)

N68-21589# Illinois Univ., Urbana. Physics Dept.

TANGENT FOCAL PLANE THEORY AND CALCULATIONS FOR THE BROWNE-BUECHNER MAGNETIC PARTICLE ANALYZER

Stephen I. Warshaw Feb. 1968 32 p refs
(Contract N00014-67A-0305-0005)
(TR-169; AD-665977)

First order focusing for the magnetic spectrometer of Browne and Buechner is discussed in the approximation where the focal surface is taken to be the plane tangent to the actual hyperbolic focal surface at the point for 90 degree bending. Expressions for magnification, dispersion, and related quantities are derived for arbitrary source-to-magnet distances, and compared with those for the hyperbolic case. Results of numerical calculations as applied to the University of Illinois 26 inch spectrometer are discussed. Author (TAB)

N68-21648*# Old Dominion College, Norfolk, Va. Physics Dept.

INVESTIGATION OF SPECTRAL PROPERTIES OF ULTRAVIOLET GRATINGS Semiannual Status Report, 1 Sep. 1967–29 Feb. 1968

Melvin A. Pittman 1 Mar. 1968 12 p
(Grant NGR-47-003-004)
(NASA-CR-94081; SASR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20F

To determine whether optical components are damaged when subjected to a simulated space environment, experiments were conducted to determine the possible damage caused by electron impact to plane gratings used in the ultraviolet region. As the data indicate that the electron total dose in a one-year orbit may be as high as 10^{15} electrons/cm^2, this dosage was simulated by irradiating the gratings in vacuum with a 1 MeV electron beam. The efficiency of gold replica gratings was measured as a function of wavelength. This was effected by determining the first-order to zero-order intensity ratio (I_1/I_0), which is a measure of the blaze, and the zero-order to MgF_2 mirror intensity ratio (I_0/I_m), which is a measure of the reflective power of the grating. The relative efficiency of the grating in first order was obtained by multiplying the two ratios. Figures depict the measurement results which show no deterioration in the spectroscopic performance of gold replica gratings subjected to 1 MeV electrons at a total dose of 10^{15} electrons/cm^2. M.G.J.

N68-21675# Nagoya Univ. (Japan). Inst. of Plasma Physics.

ON ION ACOUSTIC WAVES EXCITED NEAR AND ABOVE ION CYCLOTRON FREQUENCY IN A PLASMA

Noriyoshi Sato (Tohoku Univ.), Yoshihiko Yamashita (Okayama Univ.), Hiroyuki Ikezi, Nobuo Takahashi, and Tokuhiro Obiki Feb. 1968 6 p refs
(IPPJ-64) CFSTI: HC $3.00/MF $0.65

It is shown that propagation and damping of ion acoustic waves excited by means of a plane grid near and above ion cyclotron frequency have the same characteristics as those below ion cyclotron frequency. Author

N68-21694# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.

GUIDING AND SCATTERING OF ELECTROMAGNETIC FIELDS BY CORRUGATED STRUCTURES Scientific Report

David Y. Tseng Jul. 1967 249 p refs
(Contract AF 19(628)-4324)
(PIBMRI-1371-67; AFCRL-67-0609; AD-666449)

This study deals with an analysis of the guiding and plane wave scattering of electromagnetic fields by planar corrugated structures. Attention is focused primarily on the multi-mode aspects of the problem in order that the guiding properties in the leaky (complex) wave region and the scattering behavior associated with Wood anomalies of the S and P polarization (i.e., TM and TE modes) may be examined. The major portion of this work is devoted to the uniform planar corrugated structure, for which the TM and TE polarizations are analyzed in detail. Explicit expressions for the dispersion relation and reflection coefficients--valid for the various multi-mode cases considered (viz. up to two propagating modes

in each of the air and plate regions)—are derived for the above polarizations. Numerical solutions of the propagation characteristics and reflection coefficients are presented for each case considered. Analytic solutions for the more general N-depth corrugated structure (i.e., one which contains N arbitrary corrugation depths in a single period) are obtained, also. Author (TAB)

N68-21697# Naval Weapons Lab., Dahlgren, Va.
CREEPING-WAVE ANALYSIS OF ACOUSTIC SCATTERING BY ELASTIC CYLINDRICAL SHELLS
Peter Ugincius (Ph.D. Thesis—Catholic Univ.) 26 Feb. 1968 115 p refs
(NWL-TR-2128; AD-666105)

The Sommerfeld-Watson transformation is applied on the normal-mode solution of a plane wave being scattered by an infinite, elastic, cylindrical shell immersed in a fluid and containing another fluid. The resulting residue series is generated by poles which are the complex zeroes of a six-by-six determinant. These zeroes are found numerically by an extension of the Newton-Raphson method for complex functions. It is found that besides the infinity of the well-known rigid zeroes there exists a set of additional zeroes, which gives rise to generalized Rayleigh and Stoneley waves. Numerical results include scattering cross sections, phase velocities, group velocities, critical angles and attenuation factors for the dominant creeping-wave modes. Author (TAB)

N68-21725 Illinois Univ., Urbana.
PROPAGATION OF ZERO SOUND IN LIQUID He^3
William Russell Abel (Ph.D. Thesis) 1966 67 p Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6538

The propagation of sound in liquid He^3 was observed at a pressure of 0.32 atm and at frequencies of 15.4 and 45.5 MHz down to a temperature of 2m°K (1m°K = 10^{-3} °K) on the temperature scale valid for the Curie-law magnetic susceptibility of powdered cerium magnesium nitrate in the form of a right circular cylinder with diameter equal to height. As the temperature was increased, the sound attenuation increased, went through a maximum, and then decreased. The temperature at which maximum attenuation occurred was 11.3m°K for the frequency of 15.4 MHz and was 19.3m°K for 45.5 MHz. The velocity of the sound was found to be relatively temperature independent at high and low temperatures but near the attenuation maximum the velocity changed by 3.5±0.3 percent. Dissert. Abstr.

N68-21810# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RESEARCH LABORATORY OF ELECTRONICS QUARTERLY PROGRESS REPORT NUMBER 88
H. J. Zimmerman, G. G. Harvey, and S. J. Mason 15 Jan. 1968 367 p refs
(Contracts DA-28-043-AMC-02536(E); N00014-67-A-0204-0019; N00014-67-A-0204-0006; N00014-67-A-0204-0009; N00140-67-C-0210 et al)
(QPR-88; AD-665731)

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1. GENERAL PHYSICS p 1–119 refs (See N68-21811 11-23)
2. PLASMA DYNAMICS p 120–231 refs (See N68-21812 11-25)
3. COMMUNICATION SCIENCES AND ENGINEERING p 232–351 refs (See N68-21813 11-07)

N68-21811# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GENERAL PHYSICS
In its Res. Lab. of Electron. Quart. Progr. Rept. No. 88 15 Jan. 1968 p 1–119 refs (See N68-21810 11-23)

Research activities dealing with molecular beams and collisions, resonance and scattering, radio astronomy, electronics, gravitation, electrodynamics, and related topics in physics are summarized. Microwave spectroscopy, electronic instrumentation, and other types of apparatus were investigated. Three studies deal with the physical optics of invertebrate eyes; and other studies are concerned with physical electronics and surface physics. M.W.R.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-20589# Illinois Univ., Urbana. Dept. of Physics.
AN EQUATION FOR MESON STATES IN THE QUARK MODEL AND ITS APPLICATION TO A MESON BOOTSTRAP
Lawrence Gray King 20 Feb. 1968 50 p refs
(Contract N00014-67-A-0305-0005)
(AD-665663)

A differential equation for meson states is derived from the Bethe-Salpeter equation under the conditions of the quark model. The equation is shown to imply mass relations of the form K (superscript *2) - rho (superscript 2) = K (superscript 2) - pi (superscript 2). The equation is used to attempt modified bootstrap calculations of the vector and pseudoscalar meson parameters in the quark model. A bootstrap is found for the SU3 singlet states but shown not to be possible for either the octet states or the entire Q-bar Q system. The potential is the Fourier transform of the sum of one meson exchange Feynman graphs, with a hard core radius r sub o introduced as an adjustable parameter. TAB

N68-20648 New York Univ., N. Y.
MEASUREMENT OF THE ELECTRIC DIPOLE POLARIZABILITIES OF METASTABLE MERCURY
Judah Lavine (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6039

The electric dipole polarizabilities of $6s6p\ ^3P_2$ and $5d^96s^26p^3D_3$ metastable states of mercury have been measured. Using an atomic beam electric deflection method, in which the shift in an atomic beam under the influence of a known electric field is measured, the average polarizabilities of these states have been found. In addition, the polarizabilities of the M_J substates of the $^3P_2$ state have been measured using the E–H gradient balance method. The metastables are produced by electron bombardment of a ground state mercury beam and are detected by Auger ejection of an electron from a cesium coated tungsten surface. The data are interpreted by simulating the experimental conditions on a digital computer. Dissert. Abstr.

N68-20661 California Univ., Berkeley.
ANALYSIS OF STRANGE PARTICLE RESONANT STATES FROM NEGATIVE PION–PROTON INTERACTIONS
Lyndon Maurice Hardy (Ph.D. Thesis) 1966 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-5069

We systematically analyzed π^-p interactions producing strange-particle final states with an incident laboratory momentum ranging from 1.6 to 4.2 BeV/c. We find these final states to be dominated by the production of well-established resonant states. No evidence was seen for the existence of new resonant phenomena. The reactions $\pi^-p \rightarrow \gamma^0K^{*0}$ and $\pi^-p \rightarrow \gamma^0{}^*K^0$ proceed peripherally. Simple one-particle exchange does not describe the

processes $\pi^- p \rightarrow \Sigma^0 K^{*0}$ and $\pi^- p \rightarrow \Lambda K^{*0}$. The absorption model gives an adequate fit to the data for these reactions and indicates the dominance of K^* exchange over K exchange. Dissert. Abstr.

N68-20675 Purdue Univ., Lafayette, Ind.
EXCITATION FUNCTIONS FOR THE HELIUM-ION-INDUCED FISSION OF RHENIUM, LUTETIUM AND THULIUM
Grant Miller Raisbeck 1966 171 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5487

The alpha induced fission excitation functions of rhenium, lutetium and thulium have been measured in the energy interval of 30 to 80 MeV. The experimental method is a "fission track" technique, utilizing thin plastic films as detectors. Calibration of the system has permitted calculation of absolute cross sections. From the experimental cross sections, the ratio, Γ_f/Γ_n which measures competition between fission and neutron emission, has been calculated. The ratios have been analyzed using a statistical model. The resulting fission thresholds for Ir^{189}, Ir^{191}, Ta^{179} and Lu^{173} are 22.4, 23.6, 27.5 and 28.7 MeV, respectively. These results are obtained by assuming a level density parameter, $a_f = A/10$. Correlations are given showing the relationship of Γ_f/Γ_n with Z^2/A and with $E_f'-B_n'$, where E_f' and B_n' are the effective fission barrier and neutron binding energy. The results suggest that shell effects tend to persist even at excitation energies of 30 MeV. Dissert. Abstr.

N68-20713# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
PHOTOPRODUCED AND ELECTROPRODUCED MUON PAIRS Interim Scientific Report
Paul L. Rothwell (Ph.D. Thesis—Northeastern Univ.) Dec. 1967 91 p refs /ts Phys. Sci. Res. Paper No. 348
(AFCRL-67-0674; AD-665851)

Part I: Photoproduced muon pairs were measured between 470 MeV and 1070 MeV in invariant mass. The results, after suitable corrections, were compared with the predictions of Quantum Electrodynamics. A value of (0.74 plus or minus 0.20) x 10 to the -4th power was obtained for the rho branching ratio into muon pairs compared with pion pairs. Upper limits of 0.26 and 0.12 were obtained for the omega and phi decay into muon pairs compared to the rho. Part II: The differential cross section for electroproduced (elastic) muon pairs were calculated including the crossterms between the space-like and time-like diagrams. The cross sections were evaluated for regions where either the space-like or time-like terms dominate. The muon-produced electron pair cross sections were also considered. Integration was performed over the final electron for muon pairs and the final muon for electron pairs. A region is shown to exist, consistent with Yamamotos work, where the time-like case dominates. Counting rates are given for the apparatus of Part I for a carbon target and including form factor effects. Finally, zero mass, small angle approximations are derived for the differential cross sections for equal pair energies. Author (TAB)

N68-20724# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SODIUM, MAGNESIUM, CHLORINE, POTASSIUM, AND CALCIUM. PART 3: MAGNESIUM
M. K. Drake Nov. 1967 282 p refs
(Contract DA-18-035-AMC-730(A))
(GA-7829, Pt. 3; NDL-TR-89-3; AD-665361)

An investigation was made of the neutron interaction probabilities with the element magnesium. Sets of recommended total and partial neutron cross sections were prepared. The energy and angular distributions of the secondary neutrons are given. Also, gamma ray production cross sections were obtained as well as energy and angular distributions of the secondary gamma rays. In general, the recommended data were based on experimentally measured data. However, where no experimental data were available, the recommended cross sections were obtained using model calculations. Author (TAB)

N68-20725# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SODIUM, MAGNESIUM, CHLORINE, POTASSIUM, AND CALCIUM. PART 5: POTASSIUM
M. K. Drake Edgewood Arsenal, Md. Nucl. Defense Lab. Nov. 1967 133 p refs
(Contract DA18-035-AMC-730(A))
(GA-7829; NDL-TR-89-5; AD-665363)

An investigation was made of the neutron interaction probabilities with the element potassium. Sets of recommended total and partial neutron cross sections were prepared. The energy and angular distributions of the secondary neutrons are given. Also, gamma ray production cross sections were obtained as well as energy and angular distributions of the secondary gamma rays. In general, the recommended data were based on experimentally measured data. However, where no experimental data were available, the recommended cross sections were obtained using model calculations. Author (TAB)

N68-20740 Rutgers Univ., University Park, N. J.
PROTON SCATTERING FROM NUCLEI WITH COLLECTIVE DEGREES OF FREEDOM
Paul Stoler (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5284

Differential cross sections were obtained for 16 MeV protons elastically and inelastically scattered from Sm^{144}, Sm^{148}, Sm^{150}, Sm^{152}, Sm^{154}, and Yb^{174}, vibrational and rotational states and compared to results of coupled channel calculation. The results compare favorably. In addition, a theoretical description of the development of the coupled channel formalism (as applied to the collective model) is discussed, and a fairly detailed discussion of the experimental apparatus and procedures is presented. Dissert. Abstr.

N68-20756 Oregon Univ., Eugene.
INTERNAL IONIZATION DURING BETA DECAY
Paul Stephas (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-6217

In nuclear β decay, atomic excitation including ionization can occur due to (i) the sudden change in nuclear charge and imperfect overlap of parent and daughter orbital electron wave functions, and (ii) scattering of atomic electrons by the β particle ("direct collisions"). In order to evaluate the relative importance of these two processes and test the possible role of nuclear matrix elements in orbital-electron ejection, the probability of K-ionization in β decay of Tc^{99} and Pm^{147} has been measured. The total probabilities are $(4.8\pm0.3)\times10^{-4}$ and $(9.3\pm1.4)\times10^{-5}$ per beta, respectively. The number of K x rays in coincidence with β particles in a given energy interval has also been measured, in order to determine the K ionization probability as a function of β-particle energy. A strong β-energy dependence is found. Dissert. Abstr.

N68-20776 California Univ., Berkeley.
PRODUCTION OF KAON–ANTIKAON PAIRS IN NEGATIVE PION–PROTON INTERACTIONS
Richard Irwin Hess (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-5079

The 72-inch hydrogen bubble chamber was exposed to a beam of π^- mesons having laboratory momenta of 2.0, 3.1, and 4.0 BeV/c. The final states containing a $K\bar{K}$ pair included many

cases of resonance production. In particular we found evidence for production of the ϕ, A_2, D, and E mesons. The reaction $\pi^- p \rightarrow n\phi$ proceeds with a cross section of 30 ± 8 μb at 2.0 BeV/c. We have established the quantum numbers $I^G J^P = 1^- \text{ even}^+$ ($J = 0$ excluded) for the A_2 meson; though our determination is not conclusive, we favor $I^G J^P = 0^+ 1^+$ for both the D and E mesons. Dissert. Abstr.

N68-20778 California Inst. of Tech., Pasadena.
POSITIVE PION PHOTOPRODUCTION AT ANGLES FROM 6° TO 90° CM AND ENERGIES FROM 589 TO 1269 MEV
Stanley Duane Ecklung (Ph.D. Thesis) 1967 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-6065

The differential cross section for the reaction $\gamma p \rightarrow \pi^+ n$ was measured at 32 laboratory photon energies between 589 and 1269 MeV. At each energy, data have been obtained at 15 typically π^+ c.m. angles between 6° and 90°. A magnetic spectrometer was used to detect the π^+ photoproduced in a liquid hydrogen target. Two Cerenkov counters were used to reject the background of positrons and protons. The data clearly show the presence of a pole in the production amplitude due to the one pion exchange. Moravcsik fits to the 32 angular distributions are presented. The extrapolation of these fits to the pole gives a value for the pion–nucleon coupling constant of 14.5. The second and third pion–nucleon resonances are evident as peaks in the total cross section and as changes in the shape of the angular distributions. At the third resonance there is evidence for both a D5/2 and an F5/2 amplitude. The absence of large variations in the 0° and 180° cross sections implies that the second and third resonances are mostly produced from an initial state with helicity $\pm 3/2$.
Dissert. Abstr.

N68-20784 California Univ., Berkeley.
INVESTIGATION OF THE MANY-BODY, MULTI-CHANNEL PARTIAL-WAVE SCATTERING AMPLITUDE
David Jonathan Gross (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5064

An investigation of the N over D method of solving multichannel many-body unsubtracted dispersion relations is carried out. The existence of the D-Matrix in the multi-channel many-body case is proved, thus proving that all solutions of the partial-wave dispersion relations for the amplitude are given by the N over D method. An explicit integral representation for the determinent of the multi-channel two-body D-Matrix is derived in terms of the physical eigenphase shifts and a similar representation is derived for the Fredholm determinent of a connected many-body D-operator. The CDD ambiguity is discussed and Levinson's theorem is extended to the multi-channel many-body case, and to include the possibility of extinct ghosts. Three-body scattering is discussed, in detail and the generalization to n-body scattering is outlined, excluding the case where there are subenergy bound states or CDD poles. The properties of two-body eigenphase shifts are discussed.
Dissert. Abstr.

N68-20790 California Univ., Berkeley.
K^+p INELASTIC INTERACTIONS AT 2.7 BEV/C
Riley David Newman (Ph.D. Thesis) 1966 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5130

An analysis is presented of an exposure of the Brookhaven AGS 20" hydorgen bubble chamber to a 2.65 BeV/c separated K^+ beam. Channel cross sections are presented for K^+p interactions, except those corresponding to a two prong topology. A detailed study is made of the final states $K^0 p \pi^+$ and $K^+ p \pi^+ \pi^-$, which are dominated by the production of $K^*(891)$ and $N^*(1236)$. The reaction $K^+p \rightarrow K^* p$ is analysed in terms of a one meson exchange model modified by form factors, and results are compared with data at other energies. The model is found to give a very unsatisfactory account of the energy dependence of K^* production. The reaction $K^+p \rightarrow K^{*+} N^{*++}$ is analysed in terms of a pion exchange model modified to include the effects of absorption in initial and final states. No evidence is found for production of resonant states other than $K^*(891)$, $N^*(1236)$, and ω. Relations between three body final states of K^+p reactions implied by SU_3 symmetry are derived and tested. Dissert. Abstr.

N68-20811# Instituto de Investigacion Aeronautica Y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones.
E2 TRANSITION PROBABILITIES IN THE DAVYDOV MODEL
S. M. Abecasis, H. E. Bosch, and A. Plastino Aug. 1967 10 p *Its* Ser. Comun. LR19
(Grant DA-ARO-HC19-67-G0018)
(AD-664799) CFSTI: HC $3.00/MF $0.65

Ratios of E2 transition probabilities for the deexcitation of levels belonging to the ground state-, beta-, and gamma-rotational bands in the deformed region $150 < A < 190$ are calculated with the Davydov model. A general good agreement with experiment is obtained. TAB

N68-20834# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
THE MATHEMATICAL DESCRIPTION OF THE N-NUCLEON SYSTEM BASED ON TWO-NUCLEON POTENTIAL
Rurik K. Loder Jan. 1968 50 p refs
(NDL-TR-101; AD-665366)

The S-matrix for the N-nucleon system with initial and final boundaries is written as a proper combination of wave functions corresponding to the states of the N-nucleon system at the times t = negative-infinity and t = infinity. The calculation of the wave functions, obeying the Schrodinger equation, is accomplished with the aid of a reasonable approximation of the two nucleon potential derived by Hamada and Johnston. Author (TAB)

N68-20841 California Univ., Berkeley.
VIBRONIC STATES OF MOLECULAR AGGREGATES
John Henry Young (Ph.D. Thesis) 1968 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-5198

The exciton-intramolecular vibrational states of a molecular aggregate are examined. A Physical explanation of vibronic coupling is given, and approximate, analytic expressions for the eigenvalues and eigenvectors are derived which are valid for all coupling strengths and are exact in the limiting cases of weak intermolecular and weak vibronic coupling. This allows one to predict the shape of electronic bands in the aggregate from a knowledge of monomer vibrational parameters and aggregate electronic parameters. The theory agrees well with the experimental circular dichroism of the sugar–phosphate linked adenine dimer. Possible generalizations of the present work are discussed. Dissert. Abstr.

N68-20843 Princeton Univ., N. J.
COUPLED CHANNELS AND THEIR APPLICATION TO RESONANCES IN THE SCATTERING OF LOW-ENERGY NEUTRONS BY CARBON 12
John Louis Roeder (Ph.D. Thesis) 1966 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-5746

The importance of channel coupling in nuclear reactions is discussed, and the coupled Schrodinger equations solved in many-channel calculations of nuclear reactions are formulated. Their solutions are discussed in detail, particularly from the viewpoint of the transition and reaction matrices. Coupled channel computer calculations are presented for low-energy neutron scattering by C^{12} and for other examples of more general interest, in which resonances are investigated from the viewpoints of scattering cross sections, phase shifts, and poles of the transition matrix. Many of these resonances are seen to arise from channel coupling. Wherever possible, the results of our calculations are compared with analytic

results which have been obtained only for special cases. Our concluding analysis includes a discussion of the behavior of resonances near channel thresholds. Dissert. Abstr.

N68-20847 California Univ., Berkeley.
A STUDY OF THE INTERNAL CONVERSION ELECTRONS EMITTED WITHIN THREE NANOSECONDS AFTER THE SPONTANEOUS FISSION OF ^{252}Cf
Rand Lewis Watson (Ph.D. Thesis) 1966 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-5185

The spectra of internal conversion electrons of energies between 10 and 650 keV emitted in coincidence with the spontaneous fission of ^{252}Cf were measured and correlated to fragments of specific masses. The measured spectra showed well-defined structure and were analyzed by means of a least-squares peak-fitting procedure. Many of the lines were identified as K and L conversion line pairs, thus facilitating multipolarity assignments on the basis of K-to-L ratios. Estimates of intensities and halflives are also given for a large number of electron lines. Several of the analyzed electron peaks were suggested as specific examples of possible 2+ to 0+ transitions in even–even nuclides. Binding energy calculations were carried out employing a non-relativistic Hartree–Fock computer program developed by Roothaan. The K and L binding energies of Sr, Pd, Xe and Sm were calculated as a function of ionic charge ranging from the neutral atom to the fully ionized ion.
Dissert. Abstr.

N68-20849 Stanford Univ., Calif.
FORM FACTORS OF THE THREE-BODY NUCLEI. COULOMB SCATTERING AND THE FORM FACTOR OF THE PION
Geoffrey Brian West 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-4449

The dissertation is divided into two parts, each of which is concerned with electromagnetic scattering from "light" particles. In Part I relativistic corrections to Schiff's non-relativistic analysis of the three body nuclei form factors are estimated. High energy electron scattering from these nuclei is re-examined using an impulse approximation in which the intermediate nucleon states are taken to propagate and interact as free particles. We conclude that the corrections to the form factors are small ($\lesssim$5%) for $-q^2 \leq 8f^{-2}$. Part II is devoted to a discussion of the feasibility of a method suggested by Hofstadter for extracting the pion form factor from elastic $\pi^+ - \alpha$ scattering. We conclude that (i) the root mean square radius of the pion, $r_\pi \leq 1.5f$, (ii) the experimental accuracy must be improved by an order of magnitude and (iii) the best regions in which to take data (as far as a model independent result is concerned) are the regions of backward scattering. Dissert. Abstr.

N68-20851 Purdue Univ., Lafayette, Ind.
THE INTERMOLECULAR POTENTIAL AND THERMAL ELASTIC SCATTERING
John Robert Vincent Luoma (Ph.D. Thesis) 1966 234 p
Available from Univ. Microfilms: HC $10.60/MF $3.05 Order No. 67-5456

The role of the intermolecular potential in describing crossed, thermal energy molecular beam experiments was studied by means of forward and inverse computations. A forward calculation entailed assuming an intermolecular potential, and, by means of a quantum mechanical analysis of the wave representation of the elastic scattering process, calculating differential and total cross sections. By means of these forward calculations, the effects of a piecewise defined intermolecular potential upon the monoenergetic total cross section and the velocity spectrum of the total cross section were studied and discussed. An outline of the general inversion procedure, which utilized a linearized Taylor Series expansion of the fitting function in terms of its parameters coupled with a least squares procedure involving the data points, was given along with two examples that were fundamental to this study. Dissert. Abstr.

N68-20879# Stanford Univ., Calif. Dept. of Mechanical Engineering.
A STUDY OF RADIATION-INDUCED NUCLEATION OF BUBBLES IN SUPERHEATED WATER Annual Progress Report
L. W. Deitrich 15 Dec. 1967 20 p refs
(Contract AT(04-3)-326)
(SU-326-P-13-2) CFSTI: HC $3.00/MF $0.65

A bubble chamber system with its pressure cycling circuit and various controls was assembled to study radiation-induced nucleation of bubbles in superheated water. The chamber was covered with insulation and partly surrounded by a blast shield. Silicone fluid was substituted for Hg as the fluid which isolates the pressurizing N gas from the water in the bubble chamber. The fission fragment α source and a stainless steel spatula coated with U_3O_8 (93% U-235) to a thickness of 1.5 mg/cm^2 over an area of $\approx$4 cm^2 were prepared. Work on the construction of the system, bubble chamber, expansion system, optical system, instrumentation, and the radiation source is described. NSA

N68-20928# California Univ., Los Angeles. Dept. of Physics.
RESEARCH PROGRAM OF THE UCLA CYCLOTRON LABORATORY
J. Reginald Richardson and Byron T. Wright Jul. 1967 131 p refs
(Contracts N00014-67-A-0009; AT(11-1)-GEN-10)
(UCLA-10P18-4; AR2) CFSTI: HC $3.00/MF $0.65

The Nuclear Consortium, expansion of the cyclotron laboratory, and cyclotron and laboratory operations are discussed. The research covered experiments on nucleon reactions with nuclei for the study of bremsstrahlung, cross sections, elastic scattering, correlation spectra, angular distribution, polarization, and spectroscopy. Theoretical studies were few-nucleon problems, optical mode analysis, distorted wave theory, and proton dosimetry. A description of the computer is also given. NSA

N68-20938# Naval Ordnance Lab., White Oak, Md.
SOME CLASSICAL RELATIVISTIC ELECTRODYNAMIC RELATIONS DERIVED FROM SYSTEMS OF CHARGED PARTICLES
Louis F. Libelo 28 Dec. 1967 16 p refs
(NOLTR-67-190; AD-665487)

A completely non-quantum mechanical derivation was made of the macroscopic polarization-magnetization tensor from a system of discrete-, randomly translating dipoles. Also derived from the same system is the well known macroscopic equation relating the four-current density to the magnetization-polarization tensor.
Author (TAB)

N68-20939# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SODIUM, MAGNESIUM, CHLORINE, POTASSIUM, AND CALCIUM. PART 1: GENERAL INFORMATION AND DATA FORMAT
M. K. Drake, J. D. Garrison, and M. S. Allen Nov. 1967 38 p refs
(Contract DA-18-035-AMC-730(A))
(GA-7829; NDL-TR-89-1; AD-665359)

Sets of neutron and gamma ray production cross sections have been prepared for sodium, magnesium, chlorine, potassium, and calcium. The recommended sets of cross sections have been written on magnetic tape in the AWRE-AEEW format. This report gives some general information on how the evaluations were done and also on how the AWRE-AEEW format was expanded such that gamma ray production cross sections could be included. Data for the individual elements are given in AD-665 360, AD-665 361, AD-665 362, AD-665 363, and AD-665 364. TAB

N68-20946# California Univ., Berkeley. Lawrence Radiation Lab.
PRODUCTION OF K MESONS IN THREE-BODY STATES IN PROTON–PROTON INTERACTIONS AT 6 GEV/C
Mark Alan Mandelkern (Ph.D. Thesis) Nov. 1967 79 p refs
(Contract W-7405-ENG-48)
(UCRL-17943) CFSTI: HC $3.00/MF $0.65

An analysis is presented of data from an exposure of the LRL 72" liquid hydrogen bubble chamber to a 6 BeV/c proton beam. Processing of 9700 events, containing at least one observed neutral or charged decay has yielded 1748 examples of the reaction proton + proton → hyperon + K meson + nucleon. Production cross sections for these three body reactions are $\sigma(\Lambda K^+p) = 54 \pm {}^{3}_{5}$ μb; $\sigma(\Sigma^0 K^+p) = 17 \pm {}^{4}_{2}$ μb; $\sigma(\Sigma^+ K^0 p) = 26 \pm 4$ μb; $\sigma(\Sigma^+ K^+ n) = 57 \pm 7$ μb. Strong N^* production is observed in all channels. In particular one or more T = 1/2 resonant states with mass near 1700 MeV/c^2, decaying into ΛK^+, and a T = 3/2 resonance with mass 1920 MeV/c^2, decaying into ΣK, are produced. The final states $\Lambda p K^+$ and $\Sigma^+ K^+ n$ are studied in detail. In both cases the data are consistent with a single pion exchange mechanism modified by a form factor and inconsistent with kaon exchange. The remaining two reactions are found qualitatively to have these properties as well. No evidence is found for a dibaryon state in either the Λ-proton or Σ-nucleon system. Cross section relations among three-body final states of pp reactions implied by exact SU_3 symmetry are tested and found to be inconsistent with the data. Author (NSA)

N68-20947# Stanford Univ., Calif. Linear Accelerator Center.
ELECTROMAGNETIC INTERACTIONS
W. K. H. Panofsky [1967] 57 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-370) CFSTI: HC $3.00/MF $0.65

The review of experimental interactions includes recent results of pure quantum electrodynamics and also processes involving hadrons and electromagnetic interactions combined. Hadron properties examined by electromagnetic processes, including electron scattering, and high-energy photoproduction of hadrons, with restriction made to the nonresonant region, are considered. NSA

N68-20948# Los Alamos Scientific Lab., N. Mex.
THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Status Report, Period Ending 31 Oct. 1967
19 Dec. 1967 96 p refs
(Contract W-7405-ENG-36)
(LA-3831) CFSTI: HC $3.00/MF $0.65

The Presidential Supplementary Budget (Fiscal Year 1968) designated the Scyllac project for support. The Joint Committee on Atomic Energy has since approved it for construction. Scyllac support experiments (stabilization) in progress, using Scylla-IV, are reported here and are encouraging. Application of advanced computer techniques to plasma physics seems to be very successful. Since the Los Alamos CTR policy has, for many years, been to study high densities and high temperature, with theory if possible, and without it if necessary, high-β mathematical theory has been a special subject of study; the last two years have seen some progress. The important new factor, however, is the combination of theory and the computer. It seems certain that these techniques will provide results, by means of this new kind of "experimental theory," for regions of density and for systems of complexity that would virtually never be reached by closed mathematical theory. Such computer plasma simulation is not exact either; the computer is still not large enough to handle plasmas exactly, even with poor statistics. So various approximations have to be made, e.g., electrons smeared out, etc. But these approximations may be more valid than those of mathematical theory and moreover they are subject to experimental (i.e., computer) test. This report contains a computer simulation of a θ-pinch which exhibits a loss-cone instability and rapidly relaxes to a stable isotropic configuration. Already this bids fair to solve a long-standing θ-pinch puzzle, namely, that the plasma is able to stream axially out with full thermal speed a short time after the radial compression which added energy only to the radial velocity, and before enough collisions could have occurred to turn the particles from radial to axial motion. In another case, not given in detail here but to be published, the Particle In Cell (P.I.C.) method, which has been so successful in two-dimensional hydrodynamics, has been applied to the hydromagnetic case of the sheath moving down a plasma gun and contracting off the end. The agreements between the computation and the sheath pictures are strikingly close. NSA

N68-20952# Columbia Univ., New York. Dept. of Physics.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Progress Report, 1 May–31 Oct. 1967
Robert Novick 31 Oct. 1967 114 p refs
(Contract DA-28-043-AMC-00099(E))
(PR-16; AD-665396)

Research activities in the following areas are summarized: Metastable atoms and ions; Level-crossing and optical double-resonance spectroscopy; Beam laser spectroscopy; Electron excitation of molecular hydrogen; Scattering of velocity selected molecular beams; Magnetic rotation spectra; Molecular spectra of cesium and rubidium; Laser studies of molecular birefringence and optical activity; Optical laser spectroscopy of fluids; Interaction between a neutral beam and a conducting surface; Adiabatic demagnetization in the rotating frame; Nuclear magnetic resonance in fine particles; Photon-echo resonance; Brillouin scattering; Models of planetary atmospheres; X-ray polarization; X-ray telescope. TAB

N68-21023# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SODIUM, MAGNESIUM, CHLORINE, POTASSIUM, AND CALCIUM. PART 2: SODIUM
J. D. Garrison and M. K. Drake Edgewood Arsenal, Md. Nucl. Defense Lab. Nov. 1967 259 p refs
(Contract DA-18-035-AMC-730(A))
(GA-7829, Pt. 2; NDL-TR-89-2; AD-665360)

Neutron and gamma ray production cross sections sets were prepared for the element sodium. These data sets include total and partial neutron cross sections as well as the cross sections for producing deexcitation gamma rays. Information is also given for the angular and energy distribution of the secondary neutron and gamma rays. Author (TAB)

N68-21066 Iowa State Univ. of Science and Technology, Ames.
SIX AND SEVEN PION ANNIHILATION MODES OF 2.7 BeV/C ANTIPROTONS ON PROTONS
Daryl Eugene Bohning (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-5571

An investigation of the annihilation of 2.7 BeV/c antiprotons on protons into six and seven pions is presented. The experiment forming the basis of this investigation was carried out using 33 BeV Alternating Gradient Synchrotron and a 20" Shutt liquid hydrogen bubble chamber. A total six-prong cross section of 5.08±0.39 mb is found to be distributed as: $\sigma(\bar{P} + P \rightarrow 3\pi^+ + 3\pi^-) = 1.05 \pm 0.15$ mb, $\sigma(\bar{P} + P \rightarrow 3\pi^+ + 3\pi^- + \pi^0) = 2.18 \pm 0.40$ mb, and $\sigma(\bar{P} + P \rightarrow 3\pi^+ + 3\pi^- + n\pi^0, n \geq 2) = 1.69 \pm 0.55$, the balance going to kaon final states. Rho and ω production in the six and seven pion final states, respectively, are set at 1.0 ± 0.22 mb and 0.5 ± 0.27 mb, with no evidence for f^0 or ρ^* production. In addition, the six pion final state shows some indication of a newly discovered I = 0 meson state at 1670 MeV. From the data this state is estimated to decay to $\rho + \pi^+ + \pi^-$ and $2\pi^+ + 2\pi^-$ in the ratio four to one. Dissert. Abstr.

N68-21109 New York Univ., N. Y.
ON PARTLY GENTLE PERTURBATION WITH APPLICATION TO PERTURBATION BY ANNIHILATION-CREATION OPERATORS
Jan Raphael Hoegh Krohn (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-6034

A modified form of the condition of partial gentleness is introduced which does not involve any compactness property on V, and it is proved under this condition that for small λ, both H_0 and $H + H_0 + \lambda V$ have absolutely continuous spectrum in I, and that the parts of H_0 and H corresponding to the spectral in I are unitarily equivalent. The partial gentleness condition is expressed in terms of the kernel of V with respect to the spectral representation of H_0. The result is applied to the perturbation of the negative Laplacian by a multiplication operator. It turns out that, under quite general assumption on the multiplication operator, that this perturbation is gentle on the whole real axis; thus we find that for small λ the perturbated and unperturbated operators are unitarily equivalent. Perturbation by annihilation-creation operators is considered. It is proved that if V contains no pure annihilation or pure creation part, then under suitable smoothness condition on V, and if V is at most quadratic in the boson fields, the perturbation $H = H_0 + \lambda V$ is gentle in every bounded interval. Dissert. Abstr.

N68-21131# Bonn Univ. (West Germany).
PHOTOPRODUCTION OF PSEUDOSCALAR MESONS
H. Rollnik Mar. 1967 107 p refs Presented at the Intern. School of Elementary Particle Phys., Herceg Novi, Yugoslavia, 1–18 Oct. 1967
(NP-17221)

A discussion of the experimental knowledge and its theoretical interpretation for the photoproduction of single pseudoscalar mesons on nucleons is presented. A survey of experiments and an elementary outline of the semi-phenomenological treatment of the photo-excitation of isobars are given. Isospin and SU(3) considerations are also given, and the most important conclusions of the quark model are explained. More detailed theoretical attempts for isobar excitation are developed, and an account of the theoretical ideas and their main results which have led to some understanding of single pseudoscalar meson photoproduction is presented. NSA

N68-21136# California Univ., Livermore. Lawrence Radiation Lab.
KINETIC STUDY OF SCINTILLATION IN PURE ORGANIC CRYSTALS
D. Blanc, F. Cambou, and Y. Gervais de Lafond Nov. 1967 25 p refs Transl. into ENGLISH from J. Phys. (Paris), v. 25, 1964 p 319–325
(UCRL-TRANS-10166) CFSTI: HC $3.00/MF $0.65

Previous theories of the fast component of scintillation in organic crystals are perfected and generalized by setting up an equation giving the general law of variation of density of the fast-generated singlet quanta of excitation. This equation is applied to a particular case less restrictive than those of the previous theories. The hypothesis of a bimolecular activation from the lowest triplet state to the first excited singlet state is then used as a basis for a kinetic study of the slow component, from which the relative amount of this component is determined for the two cases of particle and photon excitation. Author (NSA)

N68-21140# Akademiya Nauk URSR. Kiev. Institut Teoreticheskoi Fiziki.
DISPERSION SUM RULES IN THEORY OF STRONG INTERACTIONS
V. A. Matveev, L. D. Soloviev, B. V. Struminski, A. N. Tavkhelidze, and V. P. Shelest 1967 73 p refs
(ITF-67-13)

The methods for the derivation of dispersion sum rules in strong interaction theory and the results obtained due to these rules are reviewed. The definition and properties of currents in local field are discussed, and the local vector and axial-vector currents of hadrons and their isotopic and unitary structure are considered. The principal methods of the dispersive sum rule derivation, the use of dispersive sum rules to investigate certain physical processes under the assumption of the isotopic invariance of strong interactions are covered. In particular, the Cabibbo–Radicati and the Adler–Weisberger sum rules are derived. The dispersion sum rules for meson scattering and in connection with SU(3) symmetry are discussed. Finally, an investigation is made of the problem of the saturation of sum rules by the nearest resonances, and a possible modification of the sum rules due to the high-energy contributions to dispersion sum rules is presented. NSA

N68-21141# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
NEW DEVELOPMENTS IN THE THEORY OF NUCLEAR REACTIONS [NEUERE ENTWICKLUNGEN IN DER THEORIE DER KERNREAKTIONEN]
J. Eichler Mar. 1967 221 p ref In GERMAN
(HMI-B-51)

The latest developments in the theory of nuclear reactions are reviewed and critically analyzed. The theory of stripping reactions, nuclear structure and spectroscopic factors, inelastic effects and internal excitation, two-nucleon transfer, Feshbach theory of nuclear reactions, applications of the Feshbach's theory to the elastic scattering of neutrons and to the nuclear photoeffect, neutron force functions, pairing and quasiparticles, model calculation for neutron widths and force functions, and the isobaric analog states are discussed. NSA

N68-21144# North Carolina State Coll., Raleigh.
[ON NUCLEAR PHYSICS] Progress Report, Period Ending 1 Nov. 1967
L. W. Seagondollar 1 Nov. 1967 61 p refs
(Contract AT(40-1)-3624)
(ORO-3624-1) CFSTI: HC $3.00/MF $0.65

Theoretical formalism was developed for interpreting a broader class of reactions in terms of the knock-out mechanism; and the systematics of nuclear binding energies of $A \leq 60$ nuclei, including excited states, were investigated. The reactions $^{9}Be(d,n)^{10}B$, $^{9}Be(d,p)^{10}Be$, $^{113}Cd(n,\gamma)^{114}Cd$, $^{40}Ca(He\text{-}3,\alpha)^{39}Ca$, $^{13}C(He\text{-}3,d)^{14}N$, $^{24}Mg(He\text{-}3,\alpha)^{23}Mg$, and $^{32}S(p,\gamma)^{33}Cl$ were studied experimentally, as was the beta decay of ^{194}Ir. Information on the energy levels of ^{39}Ca, ^{23}Mg, ^{237}Np, ^{239}Np, ^{14}N, ^{194}Pt, and ^{233}Pa was obtained; lifetime measurements were made for some of the levels using the γ Doppler-shift attenuation method. Techniques were developed for fabricating Ge(Li) detectors, and a three-crystal pair spectrometer using scintillation and semiconductor detectors was designed. NSA

N68-21145# Texas Univ., Austin. Center for Nuclear Studies.
[CENTER FOR NUCLEAR STUDIES] Annual Report, Jan.–Dec. 1967
Dec. 1967 107 p refs
(Contract AT(40-1)-2972)
(ORO-2972-47; AR-2) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical investigations of deuteron-induced reactions and of proton-induced reactions and scattering were performed with emphasis on isobaric analog resonances and on charge-exchange coupling in deuteron stripping. Neutron total elastic and nonelastic cross sections were measured for ^{10}B and ^{14}N. A technique for studying the electromagnetic structures of the pion was analyzed. Developments in instrumentation are also summarized. NSA

N68-21146# Southern Univ. Nuclear Inst., Faure (South Africa).
[ON NUCLEAR PHYSICS] Annual Report, Year Ending Dec. 1966

W. R. McMurray. comp. 1966 56 p refs
(NP-17216)

Neutron capture, fission, and scattering were investigated as were charged-particle reactions and scattering. The resonance absorption of γ rays from (p,γ) reactions was studied. Information on the level schemes of some nuclei was obtained. Techniques for fast neutron activation analysis of hydrogenous materials, analysis using neutron time-of-flight spectrometry with charged-particle-induced reactions, and charged-particle activation analysis were investigated. NSA

N68-21154# Paris Univ., Orsay (France). Institut de Physique Nucleaire.
RETARDED INTERACTIONS IN FERMI SYSTEMS
C. B. Dover (MIT) and R. H. Lemmer Jul. 1967 68 p refs
(Contract AT(30-1)-2098)
(IPNO/TH-100)

The nature of the two-body interactions in many fermion systems is studied from the viewpoint of meson theory. An exactly soluble model is formulated for linear coupling of a meson field to fermion density fluctuations, in which meson degrees of freedom are treated exactly, and fermion motion within the domain of the random phase approximation (RPA). Instability conditions for the RPA ground state are established. More generally, the effective two-body interaction is deduced via a Green's function technique by eliminating the meson degrees of freedom. This interaction is shown to be frequency dependent, i.e. retarded in time. The resulting interaction is then applied to the calculation of the Hartree–Fock field and the collective modes of the system via a generalized Landau equation. In the H.F. approximation, one obtains an unambiguous separation of renormalization (self-energy) effects and the nucleon–nucleon interactions themselves, the former reducing to the correct mass renormalization of the nucleon in the static limit. For reasonably small momenta ($p < p_f$), the retardation corrections to the H.F. field can be characterized by a small parameter (G_F/μ^2) ($\simeq .1$ for actual nuclear densities), where G_F = Fermi energy and μ = meson mass. The corrections become more important at high momenta and densities. In the long-wavelength limit, the frequency dependent corrections to the collective mode energies are found to be of order $(\omega/\mu)^2$, where ω = collective mode energy. For a static Yukawa interaction, a value $\lambda^2 \approx 5$ (consistent with the usual shell model values) is found for the neutral scalar coupling constant by requiring that the giant dipole collective state appear at the experimental energy. For pseudo-scalar coupling, the usual renormalized coupling constant $f^2/4\pi \approx 0.08$ is shown to yield a "breathing mode" in heavy nuclei consistent with crude estimates based on nuclear compressibilities. Author (NSA)

N68-21171# Argonne National Lab., Ill.
MC^2, A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS
B. J. Toppel, A. L. Rago, and D. M. O'Shea (Combust. Eng. Inc.) Jun. 1967 330 p refs
(Contract W-31-109-ENG-38)
(ANL-7318) CFSTI: HC $3.00/MF $0.65

The computer program MC^2, which was written to generate complete cross-section sets using an evaluated nuclear data file, is described. The mathematical formulation of the program is outlined, and a listing of the program is included. The program is written in FORTRAN for a 64-K CDC 3600 computer. NSA

N68-21175# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
EFFECTS OF REACTOR NEUTRONS ON THE PROPERTIES OF SILICON ZENER DIODES [WIRKUNG VON REAKTOR NEUTRONEN AUF DIE EIGENSCHAFTEN VON SILIZIUM ZENER DIODEN]
H. G. Wagemann and K. Zander Dec. 1967 27 p refs In GERMAN; ENGLISH summary
(HMI-B-63)

Current voltage characteristics of silicon Zener diodes belonging to the ZF family were measured for current injections of (10^{-7}–10^{-2}) A and at different temperatures before and after being irradiated successively within the neutron flux of a reactor (dose steps of fast neutrons: 10^{14} cm^{-2}, 3.10^{14} cm^{-2}, 10^{15} cm^{-2}, 3.10^{15} cm^{-2}, and 10^{16} cm^{-2}). Author (NSA)

N68-21184# United Kingdom Atomic Energy Authority, Risley (England). Central Technical Services.
ATTOW: A TWO-DIMENSIONAL SHIELDING PROGRAM
W. D. Collier and G. C. Curtis 20 Sep. 1967 57 p refs
(TRG-1466(R); JNPC-SWP/P-127) CFSTI: HC $3.00/MF $0.65

ATTOW is a shielding code programmed in FORTRAN IV for the IBM 7090 computer. It solves the multigroup diffusion equations in two dimensions for nonmultiplying media. Any number of groups is allowed but neutron transfer is only allowed from higher groups to lower. There may be up to 100×100 mesh points over a rectangle within which materials may be mapped out as required. Any distribution of neutron sources can be specified, derived if desired from the built-in removal program. Output includes flux prints, neutron currents and detector activations. The data requirements are given in detail, and the use of the program is illustrated. The method of solution of the equations is also described. Author (NSA)

N68-21186# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
INTRODUCTION TO RADIATION PHYSICS, CHAPTER 6
U. Amaldi, Jr. 5 Sep. 1967 88 p In ITALIAN; ENGLISH summary
(ISS-67/23) CFSTI: HC $3.00/MF $0.65

This issue is devoted to nuclear structure, to α β and γ radioactivity and to the laws determining the time behaviour of the activity of a radioactive sample. The last two sections contain the definition of "cross section" and a short description of the methods by which artificial isotopes are produced. Author

N68-21227*# Tennessee Univ., Tullahoma. Space Inst.
MIE-SCATTERING FUNCTION
F. Shahrokhi and P. Wolf Washington NASA Apr. 1968 17 p refs
(Grant NGR-43-001-021)
(NASA-CR-1022) CFSTI: HC $3.00/MF $0.65 CSCL 20H

For a comparison between experimental results and Mie-scattering theory, a series of calculations was made to find the normalized scattering function $f(\theta)$ from the tables of Legendre-polynomials by G. C. Clark and S. W. Churchill and from tables of scattering coefficients made by C. M. Chu, G. C. Clark, and S. W. Churchill. Author

N68-21243# Argonne National Lab., Ill.
PHYSICS DIVISION SUMMARY REPORT, JULY–SEPTEMBER 1967
Lowell M. Bollinger Sep. 1967 61 p refs
(Contract W-31-109-ENG-38)
(ANL-7384) CFSTI: HC $3.00/MF $0.65

Research on the energy dependence of high-energy K-conversion coefficients, perturbation of the statistical properties of nuclear states and transitions by interactions that are odd under time reversal, and autoionization in H_2 is reported. Summaries of papers presented at meetings and of papers accepted for publication are included. NSA

N68-21266# Rome Univ. (Italy). Istituto di Fisica.
FINITE ENERGY SUM RULES AND THE CROSSOVER PROBLEM IN K-N SCATTERING

P. Di Vecchia (Lab. Nazl. dell C.N.E.N., Frascati), F. Drago (Lab. Nazl. dell C.N.E.N., Frascati), and M. L. Paciello 6 Feb. 1968 15 p refs *Its* Nota Interna No. 156

We study the behaviour of the ω-residue functions in Kaon-nucleon elastic scattering using the "Finite Energy Sum Rules" technique. We find that both spin flip and non spin flip ω-residues show a zero near $t \approx -0.1$ $(GeV/c)^2$; this is in agreement with the usual explanation of the crossover phenomena in KN and NN elastic scattering, but in contradiction with the behaviour of the ω-residue functions deduced from other reactions. Author

N68-21268# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

ANGULAR DISTRIBUTION FOR THE ETA MESON PHOTOPRODUCTION FROM HYDROGEN AT 775–850 MEV

C. Bacci, R. Baldini-Celio, C. Mencuccini, A. Reale, M. Spinetti et al 20 Dec. 1967 11 p refs *Its* Nota Interna No. 388
(LNF-67/77)

An experiment performed on the photoproduction of the eta meson from hydrogen using a 1.1 GeV electron synchrotron is described. The forward differential cross section was measured at three energies K = 775, 800, and 850 MeV of the incident photons for different eta center of mass angles. The energy resolution was ±25 MeV. The purpose of the experiment was to investigate not far from the threshold energy on the presence in photoproduction of higher partial waves besides the dominant η-nucleon (η–N) S wave resonance. The results show that in the reaction $\gamma + p - \eta + p$ up to K = 850 MeV the differential cross section does not increase at forward angles in a sensible way. At backward angles a departure from isotropy could start between K = 800 MeV and K = 850 MeV. At the corresponding c.m. total energies the angular distributions for the reaction $\pi^- + p - \eta + n$[2,3] are clearly not isotropic. R.N.A.

N68-21294 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.

CALCULATION OF GRUNEISEN PARAMETERS FOR LEAD USING THE PSEUDOPOTENTIAL APPROACH

Ph. Schmuck (Wien Univ.) and E. Balcar 1967 13 p refs Presented at Herbsttagung der Oesterr. Physik. Ges., Innsbruck, 1967
(Contract AF 61(052)-638)
(SGAE-PH-63/1967)

Several model pseudopotentials for lead proposed in the literature are used to compute phonon dispersion relations of this metal in the symmetry directions [1,0,0], [1,1,0], [1,1,1] and to investigate their volume dependence. As result we obtain the one phonon Grüneisen parameters for these directions. They are compared with experimental results gained from inelastic neutron scattering. Author

N68-21314# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

SINGLE AND DOUBLE CHARGE EXCHANGE OF PIONS BY LIGHT NUCLEI

M. A. Locci and P. Picchi 5 Jan. 1968 9 p refs Submitted for publication *Its* Nota Interna No. 389
(LNF-68/2) CFSTI: HC $3.00/MF $0.65

The Glauber method, which considers multiple scattering effects, is used to express the angular distributions for pion light nuclei interaction for pion energies from 80–200 MeV. The basis of the Glauber method is given, and the calculations and results for $\pi^+ + B^{11} \rightarrow \pi^0 + C^{11}$ and $\pi^+ + Li^7 \rightarrow \pi^- + B^7$ are presented. The theory is shown to provide useful information on the many bodied structure of the nucleus. B.S.D.

N68-21377# Joint Inst. for Nuclear Research, Dubna (USSR).

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON HEAVY ION PHYSICS, DUBNA, OCTOBER 1966. ISSUE 1: PROTON EMITTERS AND ALPHA-DECAY OF NUCLEI [TRUDY MEZHDUNARODNOI KONFERENTSII PO FIZIKE TYAZHELYKH IONOV, DUBNA, 13–19 OKTYABRYA 1966 G. VYPUSK 1. PROTONNYE IZLUCHATELI I AL'FARASPAD YADER]

1967 100 p refs In RUSSIAN and ENGLISH Conf. held in Dubna, USSR, 13–19 Oct. 1966
(JINR-P7-3202; CONF-661035-2)

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N68-21378# Joint Inst. for Nuclear Research, Dubna (USSR).

INVESTIGATION OF IRRADIATED DELAYED PROTONS HEAVIER THAN TIN

I. Bacho, D. D. Bogdanov, Sh. Darotsi, V. A. Karnaukhov, L. A. Petrov et al *In its* Proc. of the Intern. Conf. on Heavy Ion Phys., Dubna, Oct. 1966. Issue 1: Proton Emitters and Alpha-Decay of Nucl. 1967 p 6–40 refs (See N68-21377 11-24)

Experimental methods for observing proton decay in elements heavier than tin are described, and the results of one such experiment involving tellurium 109 and 111 isotopes are discussed. In this instance, the experiment took place partially in the internal beam of a 310 cm. cyclotron, and partially within the internal beam of a 150 cm. heavy ion cyclotron. Metal targets from the radioactive isotopes molybdenum 92 and 94 were irradiated with neon 20 and 22 ions. The radiation products of this reaction were slowed down by an aluminum collector and periodically transferred to a spectrometer consisting of a proportional counter (for determining $\Delta E/\Delta x$) and a surface barrier detector (for measuring the energy). Proton spectra shapes are plotted for the various reactions. E.J.S.

N68-21379# Joint Inst. for Nuclear Research, Dubna (USSR).

ALPHA AND PROTON RADIOACTIVITY NEAR MAGIC NUMBER NUCLEI

Ronald D. Macfarlane *In its* Proc. of the Intern. Conf. on Heavy Ion Phys., Dubna, Oct. 1966. Issue 1: Proton Emitters and Alpha-Decay of Nucl. 1967. p 41–64 refs (See N68-21377 11-24)

One of the characteristics of the regions around major closed shells is that alpha decay energies vary in a discontinuous way. This is a reflection of large changes in single nucleon binding energies when shell model states just above a magic number configuration begin to be filled. The alpha decay energy of ^{212}Po is particularly high because it decays to a double closed shell daughter. Alpha decay is normally associated with the heavier elements where large nuclear Coulomb repulsion energies lead to small alpha particle binding energies. It has been possible, however, to observe alpha decay in the lighter elements in magic number regions and in very neutron deficient nuclei where Coulomb repulsion energies become large by virtue of smaller nuclear radii. We shall discuss in this paper two such areas where studies have been benefited by the availability of high energy heavy ions: the region near N=82 and near the double closed nucleus, ^{100}Sn. Author

N68-21380# Joint Inst. for Nuclear Research, Dubna (USSR).

TWO-PROTON RADIOACTIVITY

V. I. Goldanskiy *In its* Proc. of the Intern. Conf. on Heavy Ion Phys., Dubna, Oct. 1966. Issue 1: Proton Emitters and Alpha-Decay of Nucl. 1967 p 67–87 refs (See N68-21377 11-24)

The possibility of a two-proton emission is discussed in terms of a proton pair which, when emitted as an S-wave, continue to interact with each other for a sufficiently long distance under the combined Coulomb and centrifugal potential barriers. A scheme is described for the radioactive decay of beryllium 6 in which the feasibility of a two-proton emission is demonstrated. E.J.S.

N68-21381# Helsinki Univ. (Finland). Dept. of Physics.
ALPHA ACTIVITIES IN THE REGION FROM IR TO PO
Antti Siivola *In* Joint Inst. for Nucl. Res. Proc. of the Intern. Conf. on Heavy Ion Phys., Dubna, Oct. 1966. Issue 1: Proton Emitters and Alpha-Decay of Nucl. 1967 p 89–97 refs (See N68-21377 11-24)

Heavy ion bombardment techniques for studying short lived alpha activities in the medium mass region are discussed. Targets of rare earth oxides are bombarded in a helium filled chamber and the reaction products are carried through a small hole into an adjacent vacuum chamber by the gas flow and deposited on a metal surface. A surface barrier counter is used to record the alpha spectra as a function of the bombarding energy in order to determine excitation functions and as a function of time in order to measure half lives. E.J.S.

N68-21398# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz.
ATTENUATION FACTORS FOR CALCULATING THE PROTECTION OF MONOENERGETIC γ RADIATION BY HEAVY AND HEAVIEST CONCRETE [SCHWAECHUNG-SFAKTOREN ZUR BERECHNUNG DER ABSCHIRMUNG MONOENERGETISCHER γ-STRAHLUNG DURCH SCHWER- UND SCHWERSTBETON]
P. F. Sauermann and F. Crommen Dec. 1967 19 p refs In GERMAN
(JUL-509-ST) CFSTI: HC $3.00/MF $0.65

Absorption factors for the γ energies from 0.5 MeV to 10 MeV were calculated for heavy grades of reinforced concrete with densities from 2.35 to 4.82 g/cm^3. The results are presented in tables and compared in graphs. The absorption factors are helpful in the simple, fast, and accurate determination of shielding thickness requirements. Transl. by K.W.

N68-21399# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
INTEGRAL NEUTRON THERMALIZATION Quarterly Progress Report, Period Ending Jun. 30, 1967
J. R. Beyster, H. M. Antunez, G. M. Borgonovi, G. W. Carriveau, T. Gozani et al 10 Jul. 1967 107 p refs
(Contract AT(04-3)-167)
(GA-8085) CFSTI: HC $3.00/MF $0.65

Further research in the Integral Neutron Thermalization project is reported. Experimental and analytical studies include kinetics and fast neutron spectra in U^{238} spheres, resonance region in U^{238} slabs, and thermal neutron spectra in 77.4°K beryllium, and diphenyl. Angular scattering cross sections were studied in C^6H^6 and zirconium hydride. Dispersion curves for phonons in beryllium and diamonds are also included. B.S.D.

N68-21406# Deutsches Elektronen Synchrotron, Hamburg (West Germany).
ELECTROPRODUCTION OF PIONS
H. Blechschmidt, J. P. Dowd, B. Elsner, K. Heinloth, P. Karow et al Oct. 1967 12 p refs
(DESY-67/31)

A spark chamber experiment performed at the virtual photon energy from 0.7 to 3 GeV is reported. Electroproduction of single positive mesons (π) on hydrogen in the reaction $e + p \rightarrow e' + \pi^+ + n$ was measured detecting the scattered electron and produced meson (π) in coincidence. Also positive or negative mesons (π) from multiple meson (π) production in $e + p \rightarrow e' + \pi^+(\pi^-) + (N + \pi + ...)$ reactions were detected. The missing mass spectra from the second reaction was plotted for both positive and negative meson (π) production in intervals of the virtual photon energy. It is seen that the main contribution to multiple meson (π) production is due to ρ^0 production. The distribution of four-momentum squared of the virtual photon for the single-meson (π) events is also shown in three energy intervals. Finally, the cross section for electroproduction is shown as a function of the four-momentum transfer to the nucleon. NSA

N68-21448# Bettis Atomic Power Lab., Pittsburgh, Pa.
SUMOR: A FORTRAN-4 PROGRAM FOR THE PHILCO-2000 FOR NEUTRON RESONANCE CROSS SECTIONS INCLUDING LEVEL–LEVEL INTERFERENCE AND EXACT DOPPLER BROADENING
D. R. Harris and C. B. Noll Nov. 1967 33 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-518) CFSTI: HC $3.00/MF $0.65

The program SUMOR, a FORTRAN-IV program for the Philco 2000 for calculation of s-wave neutron scattering and radiative capture cross sections using Reich and Moore resonance formulas; Feshback, Porter and Weisskopf resonance formulas; and sums of single level formulas, is described. Cross sections are Doppler broadened exactly for target nuclei in Maxwellian motion. Calculated cross sections or calculated cross sections multiplied by reciprocal neutron energy are integrated between arbitrary energy limits. Author (NSA)

N68-21454# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE PERIPHERAL MODEL OF THE N+N → N+N+π PROCESS [K PERIFERICHESKOI MODELI PROTESSA N+N → N+N+π]
V. K. Suslenko 1967 39 p refs In RUSSIAN; ENGLISH summary
(JINR-P2-3597)

A theoretical analysis of the NN–NNπ process was made. A convenient reference system is suggested. The limits of the invariant changes for the process of one-meson production are determined. The differential cross sections are calculated by means of the peripheral model and the critical analysis of the calculation methods, existing previously, is made. The comparison with experimental data is also made and the applicability of the peripheral model concepts at the energy region 500 to 700 MeV is shown. Author (NSA)

N68-21461# Atomic Weapons Research Establishment, Aldermaston (England).
NEUTRON CROSS SECTION OF COPPER IN THE ENERGY RANGE 0.0001 EV TO 15 MEV. SOURCES OF DATA FOR FILES 249 TO 251 IN THE UKAEA NUCLEAR DATA LIBRARY
Susan M. Offord and K. Parker Dec. 1967 77 p refs
(AWRE-O-63/67) CFSTI: HC $3.00/MF $0.65

The sources of data for files 249 (natural Cu), 250(^{63}Cu) and 251(^{65}Cu) added to the UKAEA Nuclear Data Library in June 1967 are described. For natural copper neutron cross sections are based on evaluations by Benzi (CNEN, Bologna) and Häggbloin (Ab Atomenergi, Stockholm) with improvements taking into account more recent experimental and theoretical work. For ^{63}Cu and ^{65}Cu, (n,γ), (n,p), (n,α) and (n,2n) cross sections are given in the energy range 1 keV to 15 MeV which are consistent with the data for natural copper. Author (NSA)

N68-21516# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentazione.
STATISTICAL ANALYSIS OF SOME DATA IN THE MEASUREMENT OF PHOTOPRODUCTION ASYMMETRY OF POLARIZED GAMMA PIONS [ANALISI STATISTICA DEI DATI NELLA MISURA DELLA ASIMMETRIA NELLA FOTOPRODUZIONE DI PIONI DA GAMMA POLARIZZATI]
P. Spillantini and V. Valente 31 Oct. 1967 30 p refs In ITALIAN *Its* Nota Interna No. 379
(LNF-67/61) CFSTI: HC$3.00/MF$0.65

A FORTRAN 4 program, applicable to the IBM 7040 computer system, is developed for the statistical analysis of measurement data on photoproduction asymmetry of polarized gamma pions. Included are the logic, data acquisition, and formulas for computing errors and probabilities for searches. Transl. by F.S.

N68-21622# Syracuse Univ., N. Y. Physics Dept.
THE ELASTIC SCATTERING OF FAST IONS AND ATOMS IN GASES Final Report
H. W. Berry 31 Jan. 1968 17 p refs
(Grant DA-ARO(D)-31-214-G421)
(AROD-3940-2-P; AD-666235)

The results of two research programs are summarized: (1) the scattering of a series of ion-atom systems isoelectronic with He-He, viz. Li(+)-He, Be(++)-He, and B(+++)-He; (2) the scattering of Be(++) ions with He and Hz. TAB

N68-21629*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE OF THE EQUAL TIME ANTICOMMUTATOR OF THE BARYON CURRENT IN NEUTRAL PSEUDOSCALAR MESON THEORY
M. L. Tapper Apr. 1968 23 p refs
(NASA-TM-X-63165) CFSTI: HC$3.00/MF$0.65 CSCL 20H

The equal time anticommutator of the baryon current which is the source term of the Dirac equation is studied for the case of a neutral pseudoscalar meson interaction. A method of calculating the equal time anticommutator is given which incorporates the basic structure arising out of the Wilson hypothesis used to define the current. It is found that derivatives of $\delta^3(x-x')$ do not appear in the anti-commutator. The absence of such Schwinger terms permits a theorem to be stated regarding the high energy behavior of the spectral functions which characterize the baryon propagator. Author

N68-21759# Oak Ridge National Lab., Tenn. Neutron Physics Div.
SHIELDING CALCULATIONS FOR A 400-MEV LINEAR ELECTRON ACCELERATOR
R. G. Alsmiller, Jr., J. Barish, R. T. Boughner, and W. W. Engle Jan. 1968 47 p refs
(Contract W-7405-ENG-26)
(ORNL-4211) CFSTI: HC$3.00/MF$0.65

Shielding calculations for a linear electron accelerator may conveniently be divided into four parts: the electron-photon cascade, photoneutron production, particle transport through the shield, and the conversion of particle current leaving the shield to dose. Calculations in each of these categories have been carried out to aid in the design of the transverse shield of a 400-MeV linear electron accelerator. In particular, neutron-transport calculations, which are carried out using three approximation methods, the straightahead approximation, the straightahead approximation coupled with a low-energy discrete ordinates calculation, and the straightahead approximation coupled with a Monte Carlo calculation, are presented and compared. Shields composed of silicon dioxide and silicon dioxide with 10% water by weight are considered. Author (NSA)

N68-21765# Tokyo Univ. (Japan). Inst. of Physics.
$\eta \rightarrow 3\pi$ AND POSSIBLE LARGE VIOLATION OF PCAC FOR η
Yasunori Fujii Mar. 1968 17 p refs
CFSTI: HC$3.00/MF$0.65

The calculation of the decay of the eta-meson into three pions is re-examined and a possible large violation of PCAC for the eta-meson is suggested. Author

N68-21808# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE NEUTRON DETECTION IN THE (E,E'N) REACTION [LA RIVELAZIONE DEI NEUTRONI NELLA REAZIONE (E,E'N)]
G. Campos Venuti 3 Jul. 1967 67 p refs In ITALIAN
(ISS-67/18) CFSTI: HC$3.00/MF$0.65

Neutron detection in the (e,e'n) reaction was studied with the ≈600 MeV/c electrons extracted from the synchrotron. The kinematical conditions, the experimental solutions, and the measurements done with a standard counter are discussed. Author

N68-21844# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
MULTIPLE COULOMB SCATTERING FOR ISR
C. Pellegrini 1968 9 p refs
(LNF-68/1)

A numerical analysis is conducted to determine the rate of increase of transverse beam size and momentum spread in ISR due to multiple Coulomb scattering within the beam. The model assumed for the transverse motion is that of an oscillator subject to random variations of momentum. It is shown that the rate of variations of beam dimensions and energy spread are small on a time scale given by the beam lifetime and hence that the effect is negligible. R.N.A.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-20650 Princeton Univ., N. J.
THE EFFECT OF ELECTRON TEMPERATURE ON THE EXCITATION OF ELECTROSTATIC ION CYCLOTRON OSCILLATIONS
Alfred Martin Levine (Ph.D. Thesis) 1966 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5735

A method has been developed for heating the electrons in a thermally generated alkali plasma by the resonant absorption of electromagnetic waves at the electron cyclotron frequency. Using 0.01–1.0 watts of 10 Gc/sec microwave power, the electron temperature was increased from 0.2 eV to 1.0 eV. Excellent consistency has been found between diamagnetic measurements of plasma pressure, microwave determination of plasma density, and double probe determinations of temperature. The observed temperature increases were in quantitative agreement with computations which consider the heat loss by thermal conduction. The heating method was used to study the electron temperature dependence of the current required to excite electrostatic ion cyclotron oscillations. Contrary to the previously accepted theory of Rosenbluth, the critical current was found to increase with increasing electron temperature. A new theory is presented which properly predicts the magnitude and electron temperature dependence of the current required to excite the oscillations. Dissert. Abstr.

N68-20696 New Mexico Univ., Albuquerque.
STATISTICAL MECHANICS OF A PARTIALLY IONIZED HYDROGEN PLASMA
Paul Clarence Kepple, Jr. (Ph.D. Thesis) 1966 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6222

It is shown that it is possible to calculate the thermodynamic functions of a partially ionized hydrogen plasma without introducing a hard core or an arbitrary cutoff into the potential. The calculation of the partition function of the plasma is divided into four parts: (1) free particles, (2) bound states with discrete spectrum, (3) bound states with continuous spectrum and symmetric charge distributions, and (4) bound states with continuous spectrum and nonsymmetric charge distribution. The degree of ionization is calculated by minimizing the total free energy of the plasma with respect to the free electron concentration. This calculation results in a generalized Saha equation. Dissert. Abstr.

N68-20710# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
MHD ROUND PIPE FLOW EXPERIMENTS Final Report, Jan. 1965–Nov. 1967
Albert L. Loeffler, Jr., Algirdas Maciulaitis, and Marc Hoff Wright-Patterson AFB, Ohio ARL Dec. 1967 170 p refs
(Contract AF 33(615)-5269)
(ARL-67-0236; AD-665870)

Experiments were performed with liquid mercury flowing through electrically insulated circular channels in the presence of a uniform transverse magnetic field. The circular channels were equipped with static pressure taps along their length so that it was possible to determine the axial pressure gradient in the fully developed portion of flow. The three channels had inside diameters of 6.144, 0.800, and 0.505 cm. The maximum magnetic field was 1.9 webers/sq. m and the length of the magnetic field region was about 1.52 m. Maximum Reynolds numbers of 2,800,000 and maximum Hartmann numbers of 3012 were obtained. Friction factors are presented for the laminar and turbulent flow regimes. In addition to pressure distributions, velocity profiles were measured by means of pitot tubes in the largest test section for magnetic field of zero, 1.0, and 1.9 webers/sq. m, corresponding to Hartmann numbers of 0, 1597 or 3033, respectively, along two different traverses: a radius perpendicular to the magnetic field and a radius parallel to the magnetic field. Parallel to the magnetic field, the velocity profiles were almost completely flat for the fields of 1.0 and 1.9 webers/sq. m. The profiles perpendicular to the field, however, were fairly steep. The theoretical analyses predicted similar core velocity profiles for both laminar and turbulent flow. Author (TAB)

N68-20715# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
OVERSTABLE MODE DUE TO RESISTIVITY GRADIENTS IN A CURRENT-CARRYING PLASMA COLUMN
David C. Pridmore-Brown and Donald A. McPherson Nov. 1967 15 p refs
(Contract F04695-67-C-0158)
(TR-0158(9220-02)-1; SAMSO-TR-68-49; AD-665421)

A set of overstable modes is found for a low-beta current-carrying plasma having high gradients of resistivity. It is suggested that these modes provide an explanation for the large-amplitude, spontaneous oscillations that have been observed in a fully ionized, current-carrying plasma column. Author (TAB)

N68-20741# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Plasma Physics Research Lab.
SPATIAL RESOLUTION OF EMISSION AND ABSORPTION COEFFICIENTS IN SELF-ABSORBING SOURCES OF CYLINDRICAL SYMMETRY
Jorgen W. Birkeland and John P. Oss Dec. 1967 40 p refs
(ARL-67-0279; AD-665826)

An iteration technique for obtaining the radial profiles of emission and absorption coefficients in self-absorbing sources of cylindrical symmetry, and a numerical method for applying the techniques to experimental data is given. The iteration technique, involving a series of integrations and Abel inversions, is formally derived, and an IBM 7094 FORTRAN IV program for performing the calculations is listed. Author (TAB)

N68-20760# Yale Univ., New Haven, Conn.
NEGATIVE CYCLOTRON RESONANCE ABSORPTION Final Report, 15 Mar. 1965–15 Mar. 1967
Jonathan M. Wachtel (Ph.D. Thesis) 25 Aug. 1967 110 p refs
(Contract AF 19(628)-5104)
(AFCRL-67-0497; AD-665886)

The kinetic theory of waves in an infinite plasma in a uniform, constant magnetic field predicts that radiation near the cyclotron frequency in a sufficiently non-thermal plasma may grow in time. One effect which can cause such growth or negative cyclotron resonance absorption of radiation which propagates perpendicular to the magnetic field direction is the relativistic energy dependence of the electrons mass. Another is the energy dependence of the electron-atom collision cross section for low energy electrons in a neutral gas background. The cyclotron resonance absorption of microwave energy by monoenergetic electrons which drift through a cavity resonator has been measured in order to verify these predictions. In each case the observed absorption spectra are similar to those calculated in a perturbation theoretical solution of the Boltzmann equation treating the cyclotron resonance interaction between the electron beam and the bounded standing wave fields of the cavity resonator. An experiment which exhibits the radiative response in time of a weakly relativistic, monoenergetic electron ensemble to a short pulse of cyclotron resonance radiation is also described. The radiation calculated in an exact solution of the Boltzmann equation is found to occur in repetitive bursts of diminishing amplitude following the stimulating pulse. Experiment and theory are observed to be in qualitative agreement. Author (TAB)

N68-20773 Oklahoma Univ., Norman.
INVESTIGATION OF THE FAST STRIATIONS IN PREBREAKDOWN OF A GAS DISCHARGE USING MICROWAVE RECEIVER TECHNIQUES
Hassan Qassemzadeh (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-3981

The basic phenomena leading to the existence of the wave of stratification after an unstriated glow discharge is externally perturbed, is given. The mathematical formulation of the problem based on these phenomena leads to formulations that predict the presence of slow as well as fast striations. Measurement is made of the velocity of the fast striation immediately after ionization begins in the discharge tube. The results are of the same order of magnitude as those predicted by an analysis made for the case when an unstriated positive column is externally perturbed in order to artificially produce striations. It is concluded that (a) perhaps there is an inter-relationship among the parameters of striations occurring immediately after ionization is initiated, during the entire period of prebreakdown and in the positive column of a glow discharge, and (b) the phenomena leading to striations start with the beginning of ionization and grow with its growth. Dissert. Abstr.

N68-20812# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
TRANSMISSION THROUGH AN ANISOTROPIC PLASMA SLAB AT ARBITRARY ANGLES OF INCIDENCE
Kurt A. Graf Jun. 1967 34 p refs
(Contract AF 19(628)-4071)
(RCA Res. Rept.-7-801-59; SR-6; AFCRL-67-0624; AD-665871)

The transmission of plane electromagnetic waves incident at an arbitrary angle through an anisotropic slab of plasma is

considered. Utilization of the boundary conditions at both surfaces of the slab results in a series of eight simultaneous equations for the field components. Since some of the coefficients of these equations (treated as an 8 x 8 matrix) are zero, the transmitted components of the electric field which are vertically polarized or horizontally polarized can be found in terms of the vertically and horizontally polarized electric field components of the incident wave by solving three 4 x 4 matrices. Numerical results are presented for the case where the magnetic field is oriented normal to the surfaces of the plasma slab. Author (TAB)

N68-20813# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
NEUTRON AND X-RAY PRODUCTION IN A FOCUSED Z-PINCH
David A. Meskan, Hugo L. L. van Paassen, Gerald G. Comisar Dec. 1967 22 p refs
(Contract F04695-67-C-0158)
(TR-0158(3220-50)-1; SAMSO-TR-68-50; AD-665416)

Diagnostic studies were made of the neutrons and x rays produced by a paraboloidal geometry Z-pinch device (700 mTorr D2, 15 kJ). The neutron energy spectra at zero and 180 deg relative to the electric field applied at the pinch axis were obtained by nuclear emulsion techniques; they resemble the spectra obtained for linear pinches. The energy anisotropy can be explained in terms of a 90- to 130-keV deuteron beam that strikes stationary deuterons. Ross filters reveal complex x-ray spectra from 7 to 88 keV, while absorber studies reveal x radiation up to 350 keV. The spectrum from 7.11 to 29.2 keV is insensitive to neutron yield and fits the function omega to the -1.7 power, as does plasma bremsstrahlung from the electron energy distribution E to the -2.2 power. The relationship between the power-law spectrum and current MHD turbulence theories is discussed. The presence of energetic x rays and fast deuterons is not consistent with the boiler model of neutron production recently proposed by the Fillipovs. Author (TAB)

N68-20825*# Case Inst. of Tech., Cleveland, Ohio.
WAVE INTERACTION IN NON-RELATIVISTIC ELECTRON BEAM-PLASMA SYSTEMS
Gerald A. Otteni Jul. 1967 179 p refs
(Grant NsG-198; Contract AF 19(628)-1699)
(NASA-CR-93962; A-53; AFCRL-67-0375; SR-17) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A theoretical model based on the linearization of the field equations and Maxwell's equations for wave interaction in a uniform plasma which is interpenetrated by a nonrelativistic electron beam is developed. The effects of electron-neutral and electron-ion collisions and temperatures of both the beam and plasma electrons are included and no quasi-static approximation is made for the electro-magnetic field. An external d.c. magnetic field is assumed to act so that a general formulation is developed which is valid in the limit of small d.c. magnetic fields and in the limit as the field becomes very large. Graphs of the computer solutions are given for the propagation constants in a beam-plasma system for the cases of an unbounded system and for the TM wave solutions that may exist in an axisymmetric cylindrical system in which the finite beam interpenetrates an unbounded plasma. Author

N68-20844 North Carolina State Coll., Raleigh.
STABILITY ANALYSIS OF A LINEAR HALL CURRENT ION ACCELERATOR
George Walker Garrison, Jr. (Ph.D. Thesis) 1966 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5665

A normal mode analysis is used to investigate the stability of a screw type perturbation observed in the Hall current ion accelerator. Due to the similarities between this instability and that observed in the positive column discharge, the governing conservation equations are taken to be those for a weakly ionized collision dominated plasma which are normally used in the description of the positive column. The system has been found to be stable to this perturbation in the absence of an axial magnetic field, with or without a center core. When the axial magnetic field is included, the system is unstable to a right-handed helical perturbation ($m = -1$) even for small values of the axial magnetic field. The radial magnetic field has a stabilizing effect on the system. However, for a certain range of parameter values, no neutral stability point is found, and the system is unstable for all values of electric and magnetic fields investigated. Dissert. Abstr.

N68-20875# Nihon Univ., Tokyo (Japan). Dept. of Physics.
ANNUAL REPORT, 1967
1967 86 p refs
(NUP-A-68-2) CFSTI: HC $3.00/MF $0.65

This report summarizes research activities during the academic year of 1967. Short articles are presented on the major research subjects, which include the following: (1) experimental and theoretical work in plasma physics, including fast theta pinch observations, nonlinear phenomena in plasma, and plasma oscillations in magnetic fields; (2) solid state and low temperature physics studies of superconductors and magnetic materials; (3) theoretical research in elementary particles, quantum field phenomena, and low energy nuclear physics; and (4) a historical evaluation of several theoretical schemes of physics. A complete list of publications and preprints of works pertaining to these subjects is included for the period covered. K.W.

N68-20881# Stanford Univ., Calif. Inst. for Plasma Research.
FURTHER COMPUTER EXPERIMENTS ON ANOMALOUS DIFFUSION Final Report
R. W. Hockney Oct. 1967 66 p refs
(Contract AT(04-3)-326)
(SU-IPR-202) CFSTI: HC $3.00/MF $0.65

The basic properties of two dimensional particle models were studied and experiments on anomalous diffusion across a magnetic field were performed. The magnitude and correlation of computer noise (random fields arising from computer errors) were measured and agree well with various theoretical estimates. The transport of particles was observed at various magnetic fields and shows a B^{-1} dependence as predicted by Bohm. However, no dependence on temperature was found. Techniques have been developed for using larger time steps in the calculation than previously used, thus enabling longer periods of physical time to be studied Author (NSA)

N68-20887 Illinois Univ., Urbana.
THE THEORETICAL AND EXPERIMENTAL DETERMINATION OF THE INPUT IMPEDANCE OF A SMALL LOOP OF ELECTRIC CURRENT IMMERSED IN AN ANISOTROPIC PLASMA
Graham Lyman Duff (Ph.D. Thesis) 1966 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-6601

The exact expression for the input impedance of a small loop of uniform electric current is derived for the case when the loop is immersed in an infinite, homogeneous, cold, anisotropic plasma. The loop impedance is calculated by two methods of approximation for the case where the imposed steady magnetic field is normal to the plane of the loop. The first method uses the quasi-static approximation, for which a first order correction term is also calculated. The second approximate method involves the assumption that the medium is uniaxial. The loop impedance is also calculated under the uniaxial approximation for the case where the imposed steady magnetic field is parallel to the loop. The theoretically derived impedance formulas are numerically evaluated for a wide range of the plasma parameters and the measured loop impedance is compared to the theory. Dissert. Abstr.

N68-20890 Tulane Univ., New Orleans, La.
A STUDY OF THE INTERCHANGE INSTABILITY IN ELECTRON–CYCLOTRON-HEATED PLASMAS
Edmund Harris Christy, Jr. (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-3837

Experiments have been performed on a hot electron plasma produced in a magnetic mirror configuration by electron cyclotron resonance heating. Using the Physics Test Facility of the Oak Ridge National Laboratory, the flute instability has been observed and measurements of the phase velocity of the wave made. The $l=2$ mode was found dominant in this machine but higher order flutes were also observed. The shorter wavelength modes appear to be the first to grow and persist even when the longer wavelengths are damped. Measurements of the bremsstrahlung emission permit determination of the energetic electron energy distribution and density. The phase velocity of the flutes corresponds closely to the electron gradient B drift velocity. Interferometric measurements of the density of the cold plasma at the threshold of the instability show it to be approximately 5% as dense as the energetic component. This figure is compared to representative theoretical treatments and found to be in reasonable agreement with a simplified finite-length dielectric plasma model. Dissert. Abstr.

N68-20940*# Iowa State Univ. of Science and Technology, Ames. Dept. of Physics and Astronomy.
THE SCATTERING OF CHARGED PARTICLES IN A WEAKLY UNSTABLE PLASMA
Celso Roque Mar. 1968 25 p refs
(Grant NGR-16-001-043)
(NASA-CR-93970; Rept.-68-14) CFSTI: $3.00 CSCL 20I

The mean-square deflection of suprathermal test particles from a weakly unstable electron plasma is calculated. The instability is assumed to have been driven by a tenuous beam of energetic electrons. The random phase approximation expression for the spectral density is used and the electric field energy density of the turbulent spectrum is estimated by the quasi-linear theory. It is shown that the mean-square scattering angle can be increased by more than an order of magnitude by a suitable beam density or drift velocity. This enhances the potential usefulness of charged particle scattering as a diagnostic tool for turbulent laboratory plasmas. Author

N68-20949# Stanford Univ., Calif. Inst. for Plasma Research.
RESEARCH ON ANOMALOUS DIFFUSION AND INSTABILITIES IN INHOMOGENEOUS PLASMAS Final Report
K. I. Thomassen Nov. 1967 39 p refs
(Contract AT(04-3)-326)
(SU-IPR-207) CFSTI: HC $3.00/MF $0.65

An experiment on anomalous diffusion in the cold-cathode reflex discharge is given, showing the relation between a low-frequency instability and enhanced loss. Also, a general treatment of single-particle transport in random electric and magnetic fields is treated. Finally, an experiment on stabilization of drift waves by an applied random field at the electron cyclotron frequency is explained. Author (NSA)

N68-20981 California Univ., Berkeley.
A BOLTZMANN TREATMENT OF ELECTRON TRANSPORT IN MAGNETOHYDRODYNAMIC FLOW
Duncan Allan Still (Ph.D. Thesis) 1966 156 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-5175

A theoretical study of an electron gas is made to find ways to enhance the electrical conductivity of a gas (for use in a magnetohydrodynamic converter). The Boltzmann transport equation is used and it is assumed that the electron gas is sufficiently dilute so that only interaction between the electrons and atoms need be considered. The collision terms in the Boltzmann equation is treated in two different ways. The first treatment employs "age theory." The second is a straightforward integration of the collision integral, employing both the properties of a generalized binary collision and the interaction cross section. This integration is made possible with the use of a delta function to pick out the allowed values of the electron velocity before the collision. The Boltzmann equation is expanded in spherical harmonics and the expansion is truncated after two terms. The resulting equations are solved by the procedure of taking moments over all speed. The various moment equations are then truncated eventually giving the final solutions. Dissert. Abstr.

N68-20982# United Kingdom Atomic Energy Authority, Culham (England).
HIGH FREQUENCY ELECTROSTATIC WAVES IN A NON-UNIFORM PLASMA IN THE PRESENCE OF A MAGNETIC FIELD
C. N. Lashmore-Davies Aug. 1967 17 p refs
(CLM-R-75) CFSTI: HC $3.00/MF $0.65

High-frequency electrostatic waves which only propagate in the presence of a density gradient and a magnetic field are described. The analysis is made in cylindrical geometry and both conducting wall and vacuum boundary conditions are considered. When the wave velocity has a component along the steady magnetic field there are two branches of the dispersion relation. The two branches are compared with the two branches of the low-frequency drift waves. Landau damping is shown to be negligible for these high-frequency waves provided the wavelength along the magnetic field is much greater than the Debye length, but collisional damping of the wave is described. Finally, in two appendices, the use of the fluid approximation and the electrostatic approximation is justified. Author (NSA)

N68-20996*# Case Inst. of Tech., Cleveland, Ohio. Plasma Research.
PROPAGATION AND WAVE GUIDES FILLED WITH WARM PLASMA
Philip W. Nield Jun. 1967 216 p refs
(Grant NsG-198; Contract AF 19(628)-1699)
(NASA-CR-93914; TA-52; AFCRL-67-0419; SR-16) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The linearized equations describing the propagation of the normal modes in a plasma filled waveguide at microwave frequencies and in the presence of an axial constant magnetic field are derived from moments of the Boltzmann equation. Collisions are retained. For two cases where the plasma is assumed to be drifting but uniform or stationary but non-uniform in the transverse plane it is possible to completely solve for the fields by solving a set of coupled equations for the axial electric and magnetic fields and the pressure. If the plasma is assumed to be stationary and uniform these reduce to a set of coupled Helmholtz equations. Solutions for this case are considered in detail. The equations can be simplified considerably and cast into a form very similar to those used to describe wave propagation in a cold plasma. Solutions are obtained by employing an iterative technique. Author

N68-20999# Princeton Univ., N. J. Plasma Physics Lab.
EXPERIMENTAL DETERMINATION OF ELECTRON IMPACT IONIZATION RATE COEFFICIENTS FOR NEON IONS
D. L. Mickey Jan. 1968 63 p refs
(Contract AT(30-1)-1238)
(MATT-582) CFSTI: HC $3.00/MF $0.65

Rate coefficients for collisional ionization of the ions Ne^{+} through Ne^{6+} were measured in several ohmically heated hydrogen discharges of the C stellarator, with 0.25 to 4% neon added. The electron densities were between 10^{12} and 4×10^{13} cm^{-3}, electron temperatures determined from the electrical conductivity of the plasma were between 8 and 100 eV. Neon ion densities were obtained as a function of time in the discharge from

measurements of the intensities of resonance multiplets in each ion, on the basis of an assumed energy dependence for the excitation cross sections. The magnitudes of the excitation cross sections were determined from approximate oscillator strengths for the transitions, adjusted to give agreement with the known total neon density and with predicted populations of metastable terms. The metastable terms were found to have near-equilibrium populations, except in Ne^{5+} and Ne^{6+}, where equilibrium populations were observed only at high electron densities. Ionization rate coefficients deduced from the time dependence of the ion densities in discharges with different density and temperature behavior agree well, but the rate coefficients for higher stages of ionization are larger, and depend less strongly on temperature, than expected. The discrepancies are probably due to a moderate ($\approx$15%) systematic error in the conductivity temperature, and to ionization cross sections which have maxima considerably nearer threshold than was assumed. Author (NSA)

N68-21010# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

DESIGN AND EVALUATION OF A RADIO FREQUENCY PLASMA SOURCE. PART 1: SELF-EXCITED OSCILLATOR Interim Technical Report, Dec. 1961–Dec. 1964

L. R. Boedeker, J. B. Coffin, Jr., E. E. Covert, and C. W. Haldeman Wright-Patterson AFB, Ohio ARL Dec. 1967 196 p refs
(Contracts AF 33(615)-2790; AF 33(657)-7975)
(ARL-67-0281; TR-133; AD-665895)

The design, construction and performance of a very high radio frequency discharge plasma source is discussed. The purpose of such a device in the present research program is to provide a source of nonequilibrium air plasma of suitable electrical conductivity for the operation of the traveling wave pump, an electrodeless induction plasma accelerator. The final accelerated plasma stream is sought as a flow facility for high altitude high Mach number flight simulation. A study of the plasma stream effluent from the source is made and electron energy distributions and electron density profiles are presented as a function of operating power input and pressure. The electrical conductivity of the plasma and the wall energy losses are also measured. At the lowest pressure of operation (35 millitorrs) the ratio of electron temperature to gas temperature is found to be over 200 at the point of highest gas temperature. The electrical circuits for generating the radio frequency energy and for diagnostics measurements are also discussed. Author (TAB)

N68-21050*# Case Western Reserve Univ., Cleveland, Ohio.

ELECTRON AND METASTABLE DENSITY MEASUREMENTS IN ARGON WITH A LASER HETERODYNE INTERFEROMETER

Ronald N. Cotman and W. Bruce Johnson Nov. 1967 121 p refs Sponsored in part by NSF and Goodyear Aerospace Corp.
(Grants NsG-198; NsG-(T)-42)
(NASA-CR-93917; A-54) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The spatially resolved index of refraction of a 4 mm bore by 10 cm long argon discharge tube was investigated with a dual wavelength heterodyne interferometer. Measurements were made at pressures of 0.05 torr, 0.1 torr, and 0.3 torr for discharge currents of less than one ampere. The index of refraction changes at the two probe wavelengths (λ=6328 Å and λ=11523 Å) caused by a change in discharge current have been attributed primarily to the production of plasma electrons and metastable atoms. Equations were written for the electron and metastable densities in terms of the observed index change at the two probe wavelengths. The calculated values were plotted against current for different radial positions and fill pressures. The radial distribution of electrons was studied in the 0.1 torr discharge for a current of 270 mA. The dominant electron loss process was confirmed to be ambipolar diffusion rather than free-fall to the walls. Author

N68-21070 Illinois Univ., Urbana.

EXPERIMENTAL INVESTIGATION OF THE INTERACTION BETWEEN THE ELECTRON GAS AND THE EXCITED ATOMS IN A PLASMA BY MEANS OF A XENON LASER

Robert Jerry Freiberg (Ph.D. Thesis) 1966 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6613

The study of the interaction between the electron gas and the atoms in excited states has been undertaken for a gas discharge situated in a high gain optical cavity. Of particular interest is the effect of lasering upon this interaction. Spatially resolved electron density and electron temperature measurements are presented for a dc excited 3.51 μ ($5d_{33} \rightarrow 6p_{22}$) xenon laser operating in a capillary bore tube over a pressure range of 12.5 to 25.5 m torr. Anode directed gradients in the electron and neutral gas densities are observed and are attributed to electrophoretic effects present in the closed capillary discharge tube. As a result of these gradients, the local population inversion along the axis of the tube varies and, consequently, affects the output of the 3.51 μ laser. The influence of lasering upon these low-pressure capillary xenon discharges is investigated experimentally by periodically spoiling the Q of the laser cavity by means of a mechanical chopping wheel. It is observed that lasering noticeably alters both the state of the electron gas and the populations of the excited xenon atoms. Dissert. Abstr.

N68-21096*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

RESPONSE OF A ONE-DIMENSIONAL VLASOV PLASMA TO EXTERNAL ELECTRIC FIELDS

Rollin C. Harding Mar. 1968 39 p refs
(Grant NGR-16-001-043)
(NASA-CR-93977; Rept.-68-15) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The response of a one-dimensional electron plasma confined by perfectly reflecting boundaries has been calculated numerically for several externally-maintained electric field configurations representing different physical situations. The electron distribution function is expanded in a Fourier–Hermite series. The external fields (of various wavenumbers and frequencies) are represented by equivalent charge density terms in Poisson's equation. In the first situation the external field is a standing wave oscillating at approximately the resonant frequency for the given wave-number k_0. In the second situation the external source charge density is held constant and represents a small sinusoidal inhomogeneity in the ion background. In another calculation the inhomogeneity in the background charge density is varied slowly compared with the electron plasma frequency to simulate the field seen by electrons in the presence of an ion acoustic wave. In a fourth situation the ion inhomogeneity is switched on suddenly with the electrons initially in a uniform equilibrium and eventually approaching an inhomogeneous equilibrium by Landau damping. Author

N68-21242*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COAXIAL-FLOW STABILIZATION OF AN ALTERNATING-CURRENT PLASMA ARC

Chester D. Lanzo Washington 1968 11 p refs To be presented at Fluid and Plasma Dyn. Conf., Los Angeles, 24–26 Jun. 1968 Sponsored by AIAA
(NASA-TM-X-52424) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experimental results are presented for a coaxial-flow-stabilized, ac, 12- to 22-cps (12- to 22-Hz) electric arc. The arc is maintained along the centerline of an argon jet. Coflowing streams of either helium or nitrogen surround the central argon jet. The arc is stabilized by the flow field of the two gases. General characteristics of arc behavior are described for various operating conditions. Arc length is varied from 1 to 12 inches (2.54 to 30.5 cm). Photographs of the arc at maximum intensity are shown. Author

N68-21254# Nagoya Univ. (Japan). Inst. of Plasma Physics.
BOUNDARY EFFECTS FOR DIFFUSION OF A PLASMA STREAMING ALONG A UNIFORM MAGNETIC FIELD
Johshin Uramoto Feb. 1968 17 p refs
(IPPJ-66) CFSTI: HC $3.00/MF $0.65

Effects of conducting boundary walls for a plasma are investigated by applying external potentials to their walls. The plasma is streaming almost without collisions for neutral particles along a uniform magnetic field, and through each center hole of an upper or a lower end wall along the plasma stream. A diffusional radial region across the magnetic field is divided into three parts. In the first or second region, each diffusion coefficient is very near the ion free diffusion coefficient with B^{-2}, while it hardly depends on B in the third region. If the plasma becomes collisional with an increase of pressure, all the external potentials cease to drop the plasma potential because of sheath effects while the electron components towards the upper becomes less everywhere. Therefore, that a plasma is free streaming, is essential for a penetration of external electric field and reflections of electrons on the end walls along the magnetic field which lead to an ion diffusion. Then, the transverse electric field term determined experimentally is negligible compared with that diffusion term in the diffusion equation. Author

N68-21257# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
SELF-CONSISTENT HOMOGENEOUS ISOTROPIC COSMOLOGICAL MODELS 1. GENERALITIES
Remi Hakim Mar. 1968 26 p refs
(TH-68/7) CFSTI: HC $3.00/MF $0.65

Self-consistent models of uniform universes are provided by coupling Einstein's equations to the one-particle Liouville equation; correlations between the "particles" of the cosmic gas are thus neglected. As a consequence an equation of state is not needed in the theory but rather provided from these statistical considerations. It is shown that an expanding self-consistent uniform universe behaves asymptotically as the relativistic polytrope $p \approx \mu^{5/3}$ and finally as an expanding Friedmann universe. Near the possible singularity R=0 (R=scale factor) self-consistent models are hot models. Friedmann models are shown to be a particular case of self-consistent models. Author

N68-21286# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PROPAGATION OF LONGITUDINAL ION WAVES NEAR AND ABOVE ION PLASMA FREQUENCY IN A PLASMA Research Report
N. Sato, H. Ikezi, Y. Yamashita, N. Takahashi, and T. Obiki Feb. 1968 6 p refs
(IPPJ-63) CFSTI: HC $3.00/MF $0.65

Dispersion relation of ion waves excited in a plasma of equal electron and ion temperatures is experimentally shown to be different from that reported when the electron temperature is much higher than the ion temperature. Author

N68-21287# Nagoya Univ. (Japan). Inst. of Plasma Physics.
INSTABILITY OF A PLASMA DRIFTING ACROSS A MAGNETIC FIELD Research Report
Tsuguhiro Watanabe and Yukio Midzuno Feb. 1968 19 p refs
(IPPJ-65) CFSTI: HC $3.00/MF $0.65

Longitudinal waves propagating across a magnetic field are studied theoretically. Electrons and ions of the plasma are assumed to have shifted Maxwellian velocity distributions with different mean velocities, which are perpendicular to the magnetic field. The condition obtained for an instability is formulated. Some numerial analyses are made to confirm the conclusions. Author

N68-21356# Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik.
MEASUREMENT OF ELECTRON EMISSION STREAM OF TUNGSTEN IN A CESIUM PLASMA [MESSUNG DES ELEKTRONENEMISSIONSSTROMES VON WOLFRAM IN EINEM CAESIUM-PLASMA]
Masanobu Miyake and Vinzenz Dec. 1967 40 p refs In GERMAN
(JUL-508-TP) CFSTI: HC $3.00/MF $0.65

A method for measuring the emission function on cesium coatings which was previously used on electrically heated wire emitters is applied to measure the emission on probes having plane surfaces. The measurements were performed in a cesium plasma on tungsten single crystal and polycrystal surfaces of given orientation, but the method is also applicable to electrodes produced by vapor plating or hot pressing and sintering. The radiation source in the experiments was a xenon high-pressure lamp emitting a continuum whose lower boundary was at a wavelength of approximately 2500Å. Transl. by K.W.

N68-21389# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WORK OF HIGH POWER HIGH-FREQUENCY GENERATOR INTO PLASMA LOAD [RABOTA MOSHCHNOGO VYSOKOCHASTNOTNOGO GENERATORA NA PLAZMENNUYU NAGRUZKU]
N. A. Borzunov, S. M. Osovets, Yu. F. Petrov, and I. A. Popov 7 Jul. 1967 16 p refs Transl. into ENGLISH from Inst. At. Energii Im. i. v. Kurchatova (Moscow), 1966 p 1–11
(FTD-MT-24-89-67; AD-666148)

Experiments conducted on installations with traveling waves showed that the appearance of quasi-stationary current in skin layer of plasma in direction of travel of wave can be a serious obstacle to the production of plasma isolated from the walls of the chamber. Experience further indicates that it becomes necessary to strongly increase the power of hf generators to obtain high frequency magnetic fields which will sufficiently exceed the quasi-stationary magnetic fields. The article describes an experimental installation and its operation and its operation designed to compensate for the effects of the quasi-stationary current. Author (TAB)

N68-21382# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
PRECURSOR IONIZATION DUE TO PHOTOIONIZATION OF H_2 IMPURITIES IN ARGON SHOCKS
Daniel S. Wilson and Samuel Lederman Nov. 1967 31 p refs Presented at 20th Anniv. Meeting of Am. Phys. Soc., Fluid Dyn. Div., Bethlehem, Pa., 20–22 Nov. 1967
(Contract Nonr-839(38); ARPA Order-529; Proj. Defender)
(PIBAL-1033; AD-666102)

A theory was recently proposed to explain precursor effects ahead of shock waves. An indirect test of this theory was made. Experiments were performed in a pressure driven shock tube. The driven gas was Argon and the shock Mach number was 13.2. Small amounts of H2 (2-75 microns Hg) were added to the Argon (2000 microns Hg). Precursor profiles were recorded as a function of the H2 partial pressure. These profiles are in good agreement with the theoretical calculations. Author (TAB)

N68-21484# Aerospace Corp., El Segundo, Calif. Lab. Operations.
A NEW MULTIPOLAR MODE IN BOUNDED GYROTROPIC PLASMA, APRIL-JULY 1967
Vladislav Bevc Oct. 1967 76 p refs
(Contract F04695-67-C-0158)
(TR-0158(9220-02)-3; SAMSO-TR-68-48; AD-666023)

Multipolar modes in a cylindrical, axially magnetized, cold, collisionless plasma that propagate near the cyclotron frequency are studied quantitatively. Examination of electromagnetic field patterns shows that in addition to the well-known spectrum of cyclotron modes there exists at positive azimuthal eigenvalues (n>0 in exp jn o) a mode that is distinguished by a different type of field

pattern. The electric field of this mode is predominantly solenoidal, in contrast to the cyclotron modes where a substantial part of the electric field is laminar. This mode may be of importance in thick-beam parametric amplifiers at microwave frequencies (X-band) and in beam-plasma interaction near cyclotron frequency. Author (TAB)

N68-21508# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ON THE APPLICATION OF SMALL-ANGLE ELECTRON SCATTERING TO PLASMA DIAGNOSTICS

E. L. Battle, A. L. Marvin, and A. A. Bauer Mar. 1968 23 p refs

(AFIT-TR-68-4; AD-666475)

The scattering of an electron beam injected into a plasma is described by Molieres theory of multiple collisions. Such a theory has the unique advantages of including multiple as well as single scattering, being quantum mechanically correct from the outset, and of being independent of the exact form of the differential scattering law provided only that it goes over to the Rutherford law for large angles. It is also explained how plasma diagnostics can be performed with such a technique in any of three scattering regions chosen to cover all possibilities of operation. Unavoidable finite-dimension effects inherent in any laboratory application are analyzed and shown not to negate the attractiveness or utility of the method. The uniqueness of the present method lies in its use of small angle deflections to measure charged particle number density even in weakly ionized gases, as opposed to previous large angle methods useful for measuring the number of nuclei present regardless of the completeness of the atomic shells. Author (TAB)

N68-21515# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE ANOMALOUS ABSORPTION OF ELECTROMAGNETIC ENERGY IN PLASMA [OB ANOMAL'NOM POGLOSHCHENII ENERGII ELEKTROMAGNITNOGO POLYA V PLAZME]

G. I. Suramlishvili and Yu. B. Ponomarenko 8 Sep. 1967 13 p refs Transl. into ENGLISH from An GruzSSR. Soobshcheniya (USSR), v. 40, no. 1, 1965 p 47–53

(FTD-MT-24-150-67; AD-666147)

Consideration is given to the effect of anomalous absorption of the energy of an electromagnetic wave which is perpendicularly incident to the surface $z = 0$ of a semi-infinite plasma. An expression is given for the amplitude of the wave inside the plasma in terms of the amplitude of the incident wave. The dispersion equation for potential perturbations of the stationary state is analyzed for the case where electrons are in motion with a given vector with respect to ions. The consideration is limited to the case of cold ions and motion of the ions in the wave field is disregarded. The hydrodynamic oscillations described by this analytical function are discussed. Expressions are derived for critical conditions and instability. The limits of applicability for the proposed model of energy absorption are analyzed. Author (TAB)

N68-21525# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DESIGNING OF INSTALLATION "TOKAMAK TM-3" [KONSTRUKTSIYA USTANOVKI "TOKAMAK TM-3"]

D. P. Ivanov, K. A. Razumova, and A. M. Us 30 Jun. 1967 21 p refs Transl. into ENGLISH from Inst. At. Energii Im. i v. Kurchatova. (Moscow), 1966 p 1–16

(FTD-MT-24-88-67; AD-666156)

Installation Tokamak TM-3 is intended for investigation of the confinement of hot plasma by a magnetic field of closed configuration. Plasma heating is accomplished by flow of current along the plasma column. During 1961-1965 Tokamak TM-3 was constructed, designed to produce a magnetic field with a value of up to 50 kOe when its geometry is correct. The article describes the installation in detail, including the winding of its magnetic field and its toroidal discharge chamber. Author (TAB)

N68-21535*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AN ANALYSIS OF ALOUETTE 1 PLASMA RESONANCE OBSERVATIONS

Robert F. Benson Apr. 1968 61 p refs Presented at the NATO Advanced Study Inst. on Plasma Waves in Space and in the Lab., Roeros, Norway, Apr. 1968

(NASA-TM-X-63163; X-612-68-116) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The plasma resonances observed by the Alouette I satellite were analyzed to determine (a) whether the frequencies of the cyclotron harmonic resonances follow a harmonic relation, (b) the size of the resonant excitation region, and (c) the physical nature of the observed phenomena. The major observations were: (1) When high order cyclotron harmonic resonances were observed the frequencies of these resonances deviate from the harmonic relation in that they correspond to lower values than do the lower order harmonics. (2) Some of the cyclotron harmonic resonant frequencies were found to be sensitive to changes in the electron density. (3) The frequency of occurrence of the nf_H resonances with $n > 4$ was highest when the velocity of the satellite $\vec{V}_s$ was approximately parallel to $\vec{B}$. (4) The duration of most of the plasma resonances depends on the angle β between $\vec{V}_s$ and $\vec{B}$; it increases with increasing $\cos \beta$ for the resonances at the electron plasma frequency, but decreases for the resonance at the upper-hybrid frequency. Author

N68-21544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DRIFTING INSTABILITY OF PLASMA OF DISCHARGE WITH OSCILLATORY ELECTRONS [DREYFOVAYA NEUSTOYCHIVOST' PLAZMY RAZRYADA S OSTSILLIRUYUSHCHIMI ELEKTRONAMI]

L. A. Dushin, Yu. K. Kuznetsov, and O. S. Pavlichenko 1 Sep. 1967 16 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Fiz.-Tekhn. Inst. (USSR), no. 197, 1966 p 3–11

(FTD-MT-24-67-152; AD-666145)

A study is made of previously observed increases in charged particle flux across a magnetic field, created by the discharge of oscillating electrons which produce intense low-frequency plasma oscillations. A study of these oscillations, and their genesis and frequency of occurrence as a function of plasma parameters, suggests that they are caused by the drift-dissipation instability of nonhomogeneous plasma. Author (TAB)

N68-21585# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STREAM EMISSION OF METALLIC PLASMA IN A VACUUM [ISTECHENIYE STRUI METALLICHESKOY PLAZMY V VAKUUM]

E. K. Chekalin and V. S. Shumanov 18 Aug. 1967 14 p refs Transl. into ENGLISH from the publ. "An SSSR. Energeticheskiy Institut. Issledovaniya po Fizicheskoy Gazodinamike. Izd-Vo Nauka Moscow, Nauka Publishing House, 1966 p 101–108

(FTD-MT-24-153-67; AD-666155)

In order to obtain streams of a metal plasma, use was made of the evaporation of the substance of the electrodes in a pulsed high-current discharge, followed by electrodynamic acceleration of the plasma formed. Analysis of the emission spectrum of the plasma in the visible region by means of an ISP-51 spectrograph showed the presence of the lines of the alkali metal employed, two hydrogen lines, and two lines of copper and sodium. Oscillograms of the glow intensity of the various spectral emission lines showed the plasma stream to be made up of individual plasmoids corresponding to the periodic ejections of plasma from the plasma gun. Some time-averaged parameters of the plasma streams of the alkali metal were measured. It is shown that the

averaging of the plasma parameters over a time interval of 100 microsec is fully justified: the experimentally determined average values of the plasma parameters should then be close to the true values. The study of the discharge of a metal plasma into a vacuum shows that such plasma jets can be used for investigating processes of heat transfer from the plasma stream to a solid wall and for various aerodynamic studies in plasmas. Author (TAB)

N68-21623*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PAIRS OF EMITTER AND COLLECTOR SHEATHS FOR CESIUM THERMIONIC DIODES

James F. Morris Washington Apr. 1968 56 p refs
(NASA-TN-D-4419) CFSTI: HC$3.00/MF$0.65 CSCL 20I

Coupled theoretic sheaths given approximate thermionic diodes. The sheaths result from particle emissions of electrodes affected by sheath fields and of cesium plasmas ionized by thermal electrons. By matching their net current densities, the analysis pairs collisionless emitter and collector sheaths to simulate diodes. Midway between the electrodes in both space and temperatures lie the plasmas at 1700° to 2000°K with 10^{12} and 10^{13} electrons per cubic centimeter. The emitters and collectors differ by 400° to 800°K. For these conditions, the computed outputs for the converters range from 0.01 to 1 watt per square centimeter. Although such powers fall below desired performance levels, they provide low-current checks for thermionic-diode experiments. Sheath properties for the present systems and for electrodes in plasmas with raised electron temperatures agree with equilibrium results. But the theory applies only for equilibria, near-equilibria, and relatively low net transports. Overall sheath characteristics correlate with electrode and plasma conditions. One helpful parameter is a hybrid, the emission Debye length, $\lambda_{DE} \approx 6.9 (T_E/N_{eH})^{1/2}$. This variable correlates data for these sheaths better than the plasma Debye lenth. Effective sheath widths for the present study lie between 1.7 and 2.6 emission Debye lengths. The independent variables for the present graphic correlations of sheath properties involve only electrode and plasma parameters. Because one states these conditions at the outset, the graphs allow immediate estimates of sheath characteristics–without the complex iterative calculations. Author

N68-21642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POWERFUL SOURCES OF HIGH-VOLTAGE FEED OF INJECTORS AND QUESTIONS OF VOLTAGE STABILIZATION [MOSHCHNYYE ISTOCHNIKI VYSOKOVOL'TNOGO PITANIYA INZHEKTOROV I VOPROSY STABILIZATSII NAPRYAZHENIYA]

R. P. Vasil'yev, O. N. Kachalov, A. B. Teplov, I. N. Rubtsov, and U. N. Stepanov 14 Jul. 1967 29 p refs Transl. into ENGLISH from the publ. "Institut Atomnoy Energii Im. I. B. Kurchatova" (Moscow), 1966 p 1–24
(FTD-MT-24-90-67; AD-666140)

In connection with the subject of powerful sources of high-voltage feed of injectors and questions of voltage stabilization, the article discusses basic requirements on rectifiers and system of voltage stabilization. A fundamental circuit of high-voltage feed of ionic sources is described. Details and diagrams are furnished concerning: (1) rectifier for 200 kV, 10 Amperes (VSM-200) and (2) rectifier for 130 kV, 50 A (IV-130). The article concludes with a description of systems of voltage stabilization of high-voltage supply sources. TAB

N68-21691*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BOUNDARY CORRECTIONS FOR A THREE-COIL CONDUCTIVITY/VELOCITY PLASMA PROBE

Edward W. Vendell Washington Apr. 1968 32 p refs
(NASA-TN-D-4538) CFSTI: HC$3.00/MF$0.65 CSCL 20I

A three-coil plasma probe that measures both the electrical conductivity and velocity of laboratory plasmas having low magnetic Reynolds numbers has been developed and tested. As a first approximation, it was assumed that the plasma boundary was far from and much larger than the probe. The present work was undertaken to extend the previous theory by deriving factors that correct for the presence of cylindrical boundaries. As a check on this numerical work, several computed values were compared with electrical conductivity measured in cylinders of acid. Since the agreement was satisfactory, the boundary correction factors were used to reduce data taken as the probe was swept through an argon plasma generated by a constricted-arc wind tunnel. These resultant profiles represent local conductivity and velocity values for a free plasma jet having a cylindrical boundary. It was found that the raw data underestimates conductivity and overestimates velocity. Author

N68-21812# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

PLASMA DYNAMICS

In its Res. Lab. of Electron. Quart. Progr. Rept. No. 88 15 Jan. 1968 p 120–231 refs (See N68-21810 11-23)

Plasma dynamics studies are summarized that deal with plasma physics, gaseous electronics, plasmas and controlled nuclear fission, and spontaneous radiofrequency emission from hot electron plasmas. Other research activities report the interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields as well as efforts at energy conversion. M.W.R.

N68-21814# Aktiebolaget Atomenergi, Studsvik (Sweden).

THE ELECTRON TEMPERATURE OF A PARTIALLY IONIZED GAS IN AN ELECTRIC FIELD

Frank Robben Stockholm Mar. 1968 15 p refs
(AE-313) CFSTI: HC$3.00/MF$0.65

The electron temperature of a partially ionized gas in an electric field can be determined by the collision rate for momentum transfer and the collision rate for energy transfer. Mean values of these rates are defined such that a simple expression for the electron temperature is obtained, and which depends, among other things, on the ratio of these mean rates. This ratio is calculated in the Lorentz approximation for power law cross sections, and also as a function of the degree of ionization for a helium plasma. It is pointed out that the complete results of refined transport theory can be used in calculating electron mobility and electron temperature in a multicomponent plasma without undue difficulty. Author

N68-21832*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

SHOCK-LIKE SOLUTIONS OF THE ELECTROSTATIC VLASOV EQUATION

David Montgomery and Glenn Joyce Apr. 1968 32 p refs
(Grants NGR-16-001-043; NsG-233-62)
(NASA-CR-94137; Rept.-68-24) CFSTI: HC $3.00/MF $0.65 CSCL 20I

It is shown how to construct shock-like time independent solutions of the electrostatic Vlasov and Poisson Equations in one dimension. The positive ions are assumed to be at zero temperature. The electrostatic potential is assumed to increase monotonically through the shock from zero to a constant value. The most important feature of the solution is a population of trapped electrons in the shocked plasma. In contrast to time-independent solutions based upon fluid equations, there is no upper limit on the amplitude of the shock. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-20586 California Univ., San Diego.
ELECTROCALORIC AND PIEZOCALORIC EFFECTS EXHIBITED BY DIPOLAR IMPURITIES IN CRYSTAL LATTICES
Ian Wingate Shepherd (Ph.D. Thesis) 1966 297 p
Available from Univ. Microfilms: HC $13.50/MF $3.85 Order No. 67-6387

The main purpose of this thesis is to investigate the electrocaloric and piezocaloric effects exhibited by dipolar impurities in crystal lattices and to demonstrate the similarities between paramagnetism and paraelectricity. The system used almost exclusively in these investigations is KCl doped with varying amounts of OH^- impurities. The effect is used to cool the system from 1.3°K to .36°K by a method of adiabatic depolarization. Dissert. Abstr.

N68-20597 New York Univ., N. Y.
INFRARED LATTICE VIBRATIONS IN $GaAs_yP_{1-y}$ AND $CdSe_yS_{1-y}$
Hans Willem Verleur (Ph.D. Thesis) 1966 213 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-6059

The infrared lattice vibration spectra of mixed crystals of $GaAs_yP_{1-y}$ and $CdSe_yS_{1-y}$ have been measured by reflection techniques. These crystals exhibit two distinct reststrahlen bands whose strengths and frequencies depend on y and which show considerable fine structure. A harmonic model has been developed to account for the significant features of these spectra. The main features of the model are (1) the inclusion of a clustering effect or nonrandom distribution of anions on a microscopic scale, (2) the existence of 5 distinct molecular complexes which leads to two groups of four closely spaced optical phonon modes, and (3) effective ionic charges that have both local and nonlocal parts. The model provides the frequencies and strengths of the optical phonon modes which with suitably chosen damping constants yield a good fit of the reflectivity spectra over the entire range of solid solutions. Dissert. Abstr.

N68-20598 New York Univ., N. Y.
POSITRON ANNIHILATION IN MOLECULAR SOLIDS
Irwin Spirn (Ph.D. Thesis) 1966 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-637

In search for such maxima, lifetime spectra of positrons annihilating in three organic insulators (polyethylene polytetrafluoroethylene, glycerol) were measured with high resolution over wide temperature ranges, and decomposed into three components. On analysis, the data reveal that the relative intensities of the components with the longest and shortest lifetimes, in their dependence on temperature and pressure, vary as the free volume. At elevated temperatures the longest lifetime in polytetrafluoroethylene exhibits a maximum which is interpreted to be a manifestation of the thermal motion of the lattice molecules. Dissert. Abstr.

N68-20618# Parke Mathematical Labs., Inc., Carlisle, Mass.
ENERGY SPECTRA OF SECONDARY ELECTRONS FROM METALS
Charles H. Sherman and Nan E. Gordon Nov. 1967 34 p refs
(Contract AF 19(628)-2419)
(AFCRL-67-0651; SR-8; AD-665474)

A study has been made of experimental data related to the energy spectrum of secondary electrons. Data recently obtained at AFCRL as well as data from the literature have been included. It appears that almost all of the information is consistent with an isotropic internal flux of secondaries with the low energy part of its spectrum proportional to the inverse cube power of the energy measured from the Fermi level. It is also clearly shown that Baroodys free electron model of secondary emission is not consistent with the data since it predicts an internal spectrum proportional to the inverse square power of the energy. Author (TAB)

N68-20638 California Univ., Berkeley.
THE TEMPERATURE DEPENDENCE OF THE CYCLOTRON RESONANCE RELAXATION TIME IN COPPER
Sheldon Joseph Welles (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5188

Cyclotron resonance measurements are used for the first time to measure the electron collision time on the Fermi surface of a metal. The measurements are made using a copper sample with the static magnetic field in a (110) plane of the crystal parallel to the surface of the sample (Azbel'–Kaner geometry). The temperature dependent contribution to the electron collision time is extracted from the cyclotron resonance relaxation time, measured over a wide temperature range. With the static magnetic field in the [100] direction of the copper crystal, cyclotron resonance arising from the "belly" electrons is observed from 2.78°K to 21°K. With the field in the [111] direction, cyclotron resonance arising from the "neck" electrons is observed from 2.98°K to 9.25°K. The cyclotron resonance relaxation time is found to have a T^m temperature dependence where $m = 3.05 \pm 0.14$ for the belly electrons and $m = 3.1 \pm 0.9$ for the neck electrons in copper. Dissert. Abstr.

N68-20653# Ballistic Research Labs., Aberdeen Proving Ground, Md.
VAPORIZATION WAVES IN METALS
Frederick D. Bennett and George D. Kahl Nov. 1967 49 p refs
(BRL-1383; AD-665369)

The vaporization wave hypothesis is discussed and its merits and defects are examined. The vaporizing model is visualized on thermodynamic grounds as carrying the liquid metal through a continuous succession of states either on or near the liquidus line in the two-phase region. On this line the adiabatic sound speed for wet vapor will limit the rate of propagation of the vaporization front into the liquid. Experimental data for wire explosions of Al, Ag, Cu, Au, Pb and Hg (frozen) are analyzed for wave speeds. While the influence of thermal expansions of the liquid can be accounted for theoretically, insufficient thermal data are available for the metals to permit correction of the wave speeds for this effect. The experimentally derived wave speeds are compared with theoretical values of the adiabatic sound speed in the wet vapor obtained from a modified, van der Waals equation of state. At low velocities the agreement is satisfactory but higher values deviate considerably from theory. Possible causes of the deviations are discussed. These include the crudity of the fluid dynamic model, neglect of thermal expansion, lack of information about the relationship between density and electrical conductivity and the approximation imposed by the van der Waals equation. Author (TAB)

N68-20670 Iowa State Univ. of Science and Technology, Ames.
SPECIFIC HEAT OF FCC AND D-HCP LANTHANUM FROM 1.0–10.0°K
David Lee Johnson (Ph.D. Thesis) 1966 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-5599

The specific heat of fcc and d-hcp lanthanum was measured in the temperature range from 1.0–10.0°K in both the superconducting and normal states. Values of the electronic specific heat coefficient γ and the Debye temperature θ_D were determined for both phases from the normal state measurements. The Debye temperature was found to be 140 ± 2°K for the fcc phase and 152 ± 1.5°K for the d-hcp phase. The superconducting state data

were analysed to determine whether either phase of lanthanum deviates significantly from the law of corresponding states and to compare both phases with the BCS theory and with other superconductors. Dissert. Abstr.

N68-20671 Iowa State Univ. of Science and Technology, Ames.
ELECTRICAL PROPERTIES OF METALLIC SODIUM TUNGSTEN BRONZE
Lewis Dee Muhlestein (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5609

The resistivities, Hall coefficients, and Seebeck coefficients of metallic Na_xWO_3 have been measured as functions of the sodium concentration (x-value) from x = 0.4 to x = 0.9 and as functions of the temperature from 4.2°K to 300°K. The resistivity and Hall coefficients showed an anomaly at x = 0.75 where the sodium atoms are ordered. These results are the first demonstration of ordering effects in any transport property of any tungsten bronze. At low temperatures the Seebeck coefficient consisted of a lattice contribution and a diffusion contribution. The lattice term had a part due to normal phonon–electron interactions, which decreased with increasing sodium concentration; and a part due to Umklapp phonon–electron interactions, which increased with increasing sodium concentration. The resistivities, Hall coefficients, and Seebeck coefficients are sensitive to the homogeneity of the single crystals. Dissert. Abstr.

N68-20672 Illinois Univ., Urbana.
A STUDY OF HIGH ENERGY-RESOLUTION AND AT LOW PRIMARY ENERGIES OF THE SECONDARY ELECTRON EMISSION FROM (100) TUNGSTEN
Thomas Clayton Piper (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-6698

An apparatus has been designed and constructed to study secondary electron emission at low primary energies (0–50 eV). The apparatus, which is housed in an ultrahigh vacuum system, incorporates two 127-degree cylindrical, electrostatic energy selectors, one used as a primary beam monochromator and the other as a secondary electron energy analyzer. Most data reported were obtained with a net resolution of 72 MeV, but some data were obtained with 30 MeV resolution. Deterious effects due to magnetic fields, spurious electric fields, space charge, and spuriously scattered electrons are minimized by design features outlined. Secondary energy distribution and elastic-and-inelastic reflection data are presented for primary electrons incident on both clean and gas-covered (100) tungsten. Dissert. Abstr.

N68-20684 Princeton Univ., N. J.
A MEASUREMENT OF THE HALL EFFECT IN METAL FREE PHTHALOCYANINE
Mehmet Rona (Ph.D. Thesis) 1966 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-5747

Using a differential detection technique, the Hall effect was measured in a metal free phthalocyanine crystal in the b-direction between 46°C and −6°C. The observed Hall constant was negative in sign and its temperature dependence indicated that the band theory of solids rather than a phonon assisted hopping mechanism should be considered to describe the electrical conduction in this direction. A passive four terminal model which facilitates the compensation for detector loading in the Hall effect measurements on highly resistive samples has been proposed. Dissert. Abstr.

N68-20689# Sperry Microwave Electronics Co., Clearwater, Fla.
LOW MAGNETIC SATURATION GARNETS Quarterly Progress Report, 1 Aug.–31 Oct. 1967
L. R. Hodges, Jr., G. P. Rodrigue, and G. R. Harrison Feb. 1968 49 p refs
(Contract DAAB07-67-C-0142)
(SJ-220-4526-3; QPR-3; ECOM-0142-3; AD-665384)

The substitution of gallium from 0 to 8 percent for iron in single crystal BiCaVIG was completed. The magnetization was observed to increase with initial gallium substitution then drop rapidly for gallium substitution greater than approximately 4 percent. The anisotropy field (2 K sub 1/M sub s) versus temperature is reported for an aluminum and a gallium substituted BiCaVIG. The room temperature anisotropy fields for these two materials are -35 and -16 oersteds, respectively. Reproducibility determination tests were conducted on 8 polycrystalline compositions. Two batches of each of the 8 compositions were prepared and the physical, magnetic and microwave properties compared. The agreement between properties of like compositions generally was within the accuracy of the measurement. Development was started on broadband below-resonance Y junction circulators using BiCaVIG materials in the 2000 MHz region. Good operational characteristics have been obtained over narrow frequency bands, and the impedance characteristics appear favorable for broadband operation. Author (TAB)

N68-20702 California Univ., Berkeley.
PROPAGATION AND AMPLIFICATION OF SURFACE ELASTIC WAVES ON HEXAGONAL PIEZOELECTRIC CRYSTALS
Chin-Chong Tseng (Ph.D. Thesis) 1966 77 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5182

Elastic waves at the surface of piezoelectric crystals are investigated theoretically. Expressions for the particle displacement and the electromagnetic field associated with the surface waves are derived. For the surface waves propagating over the basal plane of nonconductive hexagonal crystals, both the particle displacement and the electric field are found to be elliptically polarized in the sagittal plane. The presence of the piezoelectric field stiffens the crystals and, as a consequence, the surface wave velocity increases slightly. This difference in velocity is used as the measure of the effect of the piezoelectricity to define an effective electro-mechanical coupling coefficient for the surface waves. Surface waves in piezoelectric semiconductors are also examined theoretically. It is shown that the attenuation (or electronic loss) of the surface wave vanishes and the amplification (or gain) starts to take place when the drift velocity of the free electrons is equal to the velocity of the surface wave. Dissert. Abstr.

N68-20709 Illinois Univ., Urbana.
FAR INFRARED ABSORPTION IN SUPERCONDUCTING NIOBIUM ALLOYS
Ronald Louis Cappelletti (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-6577

The widths of the energy gaps in bulk samples of transition metal binary alloys of the system Zr–Nb–Mo have been measured by the absorption of far infrared radiation. The gap edges are sharp and there is no notable structure on the curves. No attempt was made to compare the shapes of the curves with theory, since certain parameters required for the theoretical calculation were not known. The behavior of the widths of the gaps with alloying follows qualitatively that of the transition temperatures, but the reduced gap widths in two cases are significantly different from the BCS value of 3.52. The relation between the calculated BCS interaction parameter V and the reduced gap width is found to be opposite to that in the simple metals. Results of this and other experiments can be taken to indicate that the interaction parameter V increases by a factor of about four over this alloy series. Dissert. Abstr.

N68-20719# Missouri Univ., Rolla.
A STUDY OF THE SUPERCOOLING BEHAVIOR OF HIGH PURITY LIQUID BISMUTH
Bruce Livingston Bramfitt (Ph.D. Thesis) 1966 163 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-59

It was found that the amount of oxide on the melt surface is a controlling factor in the degree of supercooling obtainable in bismuth. In the presence of a thick bismuth oxide surface layer the amount of superheat below 15°C drastically decreases the amount of supercooling due to the retention of nuclei in the surface film that promote nucleation upon cooling of the melt. A drastic reduction in supercooling resulted by the addition of small concentrations (less than about 10 ppm) of antimony and tellurium whereas the other elements had a moderate to slight effect. Since all of these elements completely dissolved in the melt, a mechanism was proposed whereby the elements are concentrated on the melt surface, either in elemental or oxide form, as a monolayer of atoms. This monolayer can act as a site for heterogeneous nucleation depending upon its crystallographic relationship to the (111) of bismuth. Dissert. Abstr.

N68-20726# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
OPTICAL PARAMETRIC SCATTERING IN ADP
Douglas Magde and Herbert Mahr Jan. 1968 33 p refs
(Contract Nonr-401(47))
(Rept.-874; TR-22; AD-665673)

The paper presents a detailed experimental study of spontaneous parametric scattering in the optical region in ammonium dihydrogen phosphate (ADP) pumped with a pulsed laser source at 3472A. The dependence of the process on crystal orientation, observation direction, pump power, crystal length and detector aperture, and the properties of bandwidth and intensity of the scattered radiation were measured and compared with predictions of a detailed theory by Giallorenzi and Tang. The parametric process covers a wide range of visible and infrared wavelengths and can be observed over a rather large range of observation directions. For a peak power of 1 MW of the pump about 1-10 microwatt of scattered radiation were obtained in a 1 cm long crystal with a detector aperture of about 0.0001 steradians. Author (TAB)

N68-20738 Pennsylvania State Univ., University Park.
ULTRASONIC REVERBERATION IN SOLIDS FOR LOSS FACTORS EXCLUSIVE OF SCATTERING AND DIFFRACTION
Bernard Earl Droney (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-5911

A reverberation method is investigated for ultrasonic loss measurements in solids at frequencies above 10 MHz. The diffuse sound field is generated by grain scattering and by reflection at the surface; in equilibrium this sound field consists of a mixture of shear and dilation waves. The investigation of the energy balance between shear and dilatation for such a uniform diffuse field shows that one equilibrium is reached the energy is mainly contained in shear modes. Measurements of signal level and loss factor characterize the energy distribution throughout the sample as reverberant rather than pulse echo in character, after an initial conversion time required to establish the diffuse field. The decay slope is related to the acoustic loss in the solid and to the losses due to surface effects. Dissert. Abstr.

N68-20739 Rutgers Univ., University Park, N. J.
THE LATTICE DYNAMICAL ASPECTS OF SOME THERMAL PROPERTIES OF IDEAL MONATOMIC CRYSTALS
Joseph Louis Feldman (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-5259

Some thermal properties of ideal monatomic crystals are treated on the basis of the Born–von Karman theory of lattice dynamics, with anharmonic terms treated as a small perturbation in the crystal Hamiltonian. The thermodynamic data of platinum is analysed on the basis of the quasi-harmonic approximation. Several moments of the vibrational frequency spectrum are obtained and are displayed in a Barron plot: The effective Debye temperature, Θ^{DW} (T), associated with the Debye–Waller factor is calculated from these moments. The remaining part of the thesis deals with anharmonic effects in the Helmholtz free energy, the entropy, and the heat capacity. The low temperature relationship between the heat capacity and the elastic constants is studied. An expression, in terms of microscopic force constants, is obtained for the effect of the zero-point energy on the second order macroscopic elastic constants and on the frequencies of the macroscopic elastic waves. Dissert. Abstr.

N68-20744# Wilkes Coll., Wilkes-Barre, Pa. Research and Graduate Center.
AMPLITUDE-DEPENDENT AND AMPLITUDE INDEPENDENT INTERNAL FRICTION IN SODIUM CHLORIDE
S. J. Holden, T. J. Woronowicz, and T. M. Heslin Wright-Patterson AFB, Ohio ARL Dec. 1967 85 p refs
(Contract AF 33(615)-1524)
(ARL-67-0272; AD-665822)

The high-amplitude decrement of pure NaCl was studied as a function of strain amplitude and time. Results show an asymmetric peak in internal friction versus maximum strain amplitude. Granato-Lucke plots yield a straight line only for the low-amplitude portion of the peak. Double-valued behavior of internal friction versus strain amplitude has sometimes been observed. Except for the case of double-valued behavior, internal friction was observed to increase and the dynamic Youngs modulus to decrease with vibration time at all strain amplitudes. It is concluded that the Granato-Lucke theory can only partially explain these results. Some discrepancies between previously observed results are resolved if the internal friction is plotted versus the free decay strain amplitude. The anelastic relaxation peaks due to impurity-vacancy complexes were studied using Ca++ doping. An attempt was made to calculate values of the zero stress jump rates. Vibration along the <100> direction should excite three relaxation modes, resulting in three possible internal friction peaks. Along the <111> direction two modes are postulated resulting in two possible peaks. Experimentally, one sharp peak was found for the <111> orientation and one broad peak for the <100> direction. Author (TAB)

N68-20746# Purdue Univ., Lafayette, Ind. Thermophysical Properties Research Center.
THE PRECISE DETERMINATION OF THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF SOLIDS AT HIGH TEMPERATURES BY DIRECT ELECTRICAL HEATING METHODS Technical Report, 1 Jul. 1966–30 Jun. 1967
R. W. Powell, D. P. De Witt, and M. Nalbantyan Wright-Patterson AFB, Ohio AF Mater. Lab. Aug. 1967 112 p refs
(Contract AF 33(615)-3861)
(AFML-TR-67-241; AD-665829)

Direct electrical heating methods possess desirable features for determinations of thermal conductivity values to high temperatures. Since unreliable data have been obtained by previous workers using these methods, a systematic evaluation of the various techniques was initiated. An apparatus capable of providing a variety of thermal/electrical boundary conditions to a single specimen as prescribed by particular techniques was designed and fabricated. With this apparatus thermal conductivity, and other thermophysical properties, can be determined on a single specimen by various methods, permitting direct evaluation and comparison of the results. In connection with this experimental effort, the theoretical models of the methods and analyses of the conditions which must be met in the experimental apparatus are being studied. The ultimate objective of the program is to devise a technique(s) suitable for determinations to temperatures of the order of 2500 C, utilizing test specimens of simple geometry and minimum volume. Author (TAB)

N68-20754 Iowa State Univ. of Science and Technology, Ames.
A MOESSBAUER EFFECT STUDY OF THE CRYSTAL FIELD POTENTIAL IN INTERMETALLIC COMPOUNDS OF THULIUM
Dennis Joseph Genin (Ph.D. Thesis) 1968 117 p
(Contract W-7405-ENG-82)
(IS-T-104) Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5588

Crystal field potentials in Tm-intermetallic compounds were investigated by measuring the temperature dependence of the nuclear quadrupole splitting of the 8.42 keV gamma transition of Tm^{169}. The quadrupole splittings were accurately determined by computer-fitting theoretical lineshapes to the data. Crystal field parameters for the C_{3v} symmetry in $TmRu_2$ and $TmMn_2$ were determined by a best fit to the temperature dependence of the quadrupole interation. In both compounds the conduction electron contribution to the electric field gradient was found to be opposite in sign to the temperature-independent lattice contribution. Large shielding of the 4f-electrons from the crystal field, expressed by the shielding factor σ_2, was noted. Anomalous line broadening at low temperatures was explained on the basis of a range of crystal field potentials at the Tm^{3+} ion sites due to lattice imperfections. Dissert. Abstr.

N68-20755 North Carolina Univ., Chapel Hill.
STRAIN EFFECTS IN THE TUNNELING CHARACTERISTICS OF SUPERCONDUCTING LEAD
Robert Edwin Hodder (Ph.D. Thesis) 1966 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-5342

Included are a critical discussion and redefinition of certain parameters of the Bardeen–Cooper–Schrieffer theory of superconductivity; a detailed calculation, from the basic tenets of the BCS theory, of the superconductor to normal metal tunneling current, which can be related to a new system of excitation spectrum tunneling diagrams; and an outline of the solution to the Eliashberg–Nambu equations of superconductivity for a strained superconductor. This thesis describes the measurement of strain-induced shifts in the gap and phonon structure in superconducting lead-insulator-lead tunneling junctions between 1.5°K and 4.2°K. Values of the strain-induced shifts in the phonon structure of the tunneling characteristic were found to vary considerably from peak to peak. However, comparison between these shifts can provide valuable insight into the problem of identifying this structure with Van Hove singularities in the phonon density of states. Dissert. Abstr.

N68-20759# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ELECTRICAL CONDUCTION IN ICE
P. R. Camp, W. Kiszenick, and D. A. Arnold Sep. 1967 62 p refs
(CRREL-RR-198; AD-665354)

In an attempt to resolve the conflict existing in the literature as to dc electrical conductivity of ice, an extensive series of measurements has been made. Since surface conduction is a possible cause of some of the confusion, both bulk and surface conductivity have been measured at dc and audio-frequencies. Evidence was found for significant surface conductivity when slight contamination was present. In order to explain these results quantitatively, it is necessary to postulate a surface conduction region whose thickness varies with temperature. Extrinsic bulk conductivity due to trace impurities has been found to play an important part also and probably accounts for some of the disagreement in the literature. Using ice of the highest purity, bulk measurements show that, for a fresh sample, the dc conductivity is nearly independent of temperature down to temperatures at which the high frequency ac and dc conductivities are about equal. The results suggest that the high frequency conductivity is limited by 2 processes in parallel and that the dc conductivity is limited by the same 2 processes in series. Author (TAB)

N68-20762# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF HYDROGEN ON ELECTRICAL RESISTANCE OF NIOBIUM [VLIYANIYE VODORODA NA ELEKTROSOPROTIVLENIYE NIOBIYA]
V. M. Pletenev 23 Aug. 1967 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), no. 5, 1965 p 113–116
(FTD-HT-66-556; AD-665701)

The effect of hydrogen on the resistivity of niobium has been investigated at 20--1000C. Hydrogen was introduced in niobium wires 1.5 mm in diameter and 1000 mm long in the amount of 0.002, 0.005, 0.01, 0.02, 0.05, 0.1 and 0.3% and the resistivity of niobium wire was determined at 20--800C and also at 500--1000C in hydrogen atmosphere under 650 mm Hg pressure. It was found that hydrogen increases the niobium resistivity, especially at temperatures up to 4000, when hydrogen content is raised from 0.01 to 0.02%. Although the mechanical properties of niobium and its alloys drop sharply at a hydrogen content of 0.02% (the elongation of niobium drops from 7--18% to 2--3%), microscopic examination revealed no structural changes. The resistivity of niobium with 0.1 and 0.3% hydrogen or that of pure niobium tested in hydrogen atmosphere under 650 mm Hg pressure increases substantially with increasing temperatures. This increase is the result of the decomposition of the secondary phase at the transition of hydrogen into solid solution. Author (TAB)

N68-20772# Massachusetts Inst. of Tech., Cambridge.
RELAXATION PHENOMENA ON INDIUM ANTIMONIDE SURFACES AT HIGH ELECTRIC FIELDS
Howard R. Huff, Shinji Kawaji, and Harry C. Gatos Jan. 1968 19 p refs
(Contract Nonr-3963(05))
(TR-10; AD-665310)

High voltage pulsed field effect experiments were performed on two surfaces of n-type InSb which were previously exposed to a mixture of chlorine and air. The observed relaxation phenomena were attributed to an emission of electrons from a slow surface state into the conduction band. These phenomena were adequately described by a quantum mechanical tunnel equation. A slow surface state was located approximately 0.04 eV below the conduction band edge on both surfaces. High voltage alternating current field effect experiments were concurrently performed on the same surfaces. Author (TAB)

N68-20780 California Univ., Davis.
PHOTOEMISSION INVESTIGATION OF THE BAND STRUCTURE OF FERROMAGNETIC Ni–Al ALLOYS
Walter Michael Breen (Ph.D. Thesis) 1966 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-5233

Photoemission measurements probing the electronic band structure of ferromagnetic Ni–Al alloys have been made using ultraviolet light from 4.5 to 11.4 eV to determine the excitation density of electronic quantum states down to about 6 eV below the Fermi level. The optical density of states determined to within 25% is the same for all the Ni–Al alloys investigated. Only the position of the Fermi level changes as Al is added, in agreement with the rigid band model. Results obtained from a pure Ni sample cleaned by argon bombardment and heat treatment are compared with those of Blodgett from a pure Ni sample formed by evaporation onto a substrate. The photoemission data from both samples are in complete agreement. A search for magnetic effects was made by taking data above the Curie temperature of the 89.6% Ni alloy. Comparison of photoemission data above the Curie point with data below it shows no change due to magnetic effects. Dissert. Abstr.

N68-20782 Illinois Univ., Urbana.
THE EFFECT OF ALUMINUM ON THE SATURATION MOMENT OF Fe–Ni ALLOYS

Denes Istvan Bardos (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-6550

The magnetization of nickel–iron–aluminum terminal solid solution alloys in the ordered and disordered state was measured by a force method between 8 and 300°K in fields up to 12.5 kOe. Mean atomic magnetic moments were calculated from saturation magnetizations at 0°K. In binary Ni–Al alloys the slope of the moment per atom vs Al-content curve is $-2.8\mu_B$ per atom. The average moment per atom vs Al-content curve in the corresponding ternary alloy series $Ni_{0.6}Fe_{0.2}$-Al, $Ni_{0.6}Fe_{0.4}$-Al and $Ni_{0.4}Fe_{0.6}$-Al was found to have initial slopes of −2.6, −3.1 and $-3.0\mu_B$ per atom respectively. The slopes of similar curves for body centered cubic iron-base alloys of the type $Fe_{0.92}Ni_{0.08}$-Al and $Fe_{0.75}Ni_{0.25}$-Al were both found to be $-4.0\mu_B$ per atom which could not be accounted for on the basis of information obtained from the binary Fe–Al and Fe–Ni alloys. Dissert. Abstr.

N68-20785 Illinois Univ., Urbana.
OPTICAL PROPERTIES OF GALLIUM ARSENIDE–PHOSPHIDE
George Dee Clark, Jr. (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-6587

Index of refraction of $Ga(As_{1-x}P_x)$ was measured as a function of photon energy by the minimum angle of deviation prism method at 300°K and 87°K. The dielectric constant in the optical region was found to vary linearly as a function of mole fraction GaP between the values for GaAs and GaP. Transmission data on $Ga(As_{1-x}P_x)$ were obtained at 300°K and 77°K. Reflectivity was calculated from the index of refraction and used to calculate absorption constant, assuming multiple internal reflections in the crystal. In the infrared, true free carrier absorption was observed for degenerate GaAs-rich mixed crystals, and absorption due to transitions from donor levels to the conduction band was observed in GaP-rich mixed crystals. The absorption edge was investigated, and the Burstein shift of the absorption edge to higher energies with increased doping was observed, as well as shifts to lower energies due to compensation. Dissert. Abstr.

N68-20791 Purdue Univ., Lafayette, Ind.
EXPERIMENTAL INVESTIGATION OF MAGNETIC COUPLING IN DIELECTRIC SOLIDS
Robert Beil, Jr. (Ph.D. Thesis) 1966 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-5420

Recent publications on the continuum theory of dielectric materials indicate the existence of certain electromagnetic cross effects hitherto unencountered in the literature. The determination of the magnitude of some of these terms and the physical reality of their presence may be investigated experimentally. The present paper is concerned with the experimental investigation of one such term and the consequences resulting from its use in theoretical investigations. The experimental investigations have been carried out using torsional pendulum techniques. Subsequent analysis of the data shows that calculated torque due to the presence of the term investigated in the constitutive equation is of the nature of the observed torque which us unaccounted for by arguments of a geometrical nature or otherwise. An approximate value of the coupling coefficient is given. Dissert. Abstr.

N68-20808# Hughes Research Labs., Malibu, Calif.
CONDENSATION AND NUCLEATION PROCESSES OF SINGLE CRYSTAL THIN FILMS Summary Technical Report, 14 Oct. 1966–14 Oct. 1967
Ryoichi Kikuchi and Morris Braunstein Wright-Patterson AFB, Ohio AF Mater. Lab. Dec. 1967 157 p refs
(Contract AF 33(615)-2869)
(AFML-TR-67-410; AD-665433)

Theoretical and experimental investigations were conducted to evaluate those parameters which affect the nucleation, condensation, and subsequent growth rates of single crystal thin films. In the theoretical program, the path probability method was used to study the process of the film growth, with the particular objective of obtaining more reliable results than those reported previously. In the experimental program, single crystal silicon films were deposited on selected areas of fused quartz substrates using vapor-liquid solid techniques in conjunction with moving-mask-growth (VLS-MMG). Silicon single crystal areas ranging from 100 to 300 microns in lateral dimension were prepared at substrate temperatures from 800 to 900C. Optical and electron microscope and electron transmission diffraction observations were made of typical film sample areas. A vacuum system with a stainless steel chamber was set up for experiments so that slower rates of silicon deposition and mask motion could be achieved. TAB

N68-20816# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Summary Report No. 4, 1 Aug.–31 Oct. 1967
Alan L. McWhorter 31 Jan. 1968 69 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-562; AD-665465)

The report covers in detail the solid state research work at Lincoln Laboratory for the period 1 August through 31 October 1967. The topics covered are Solid State Device Research, Optical Techniques and Devices, Materials Research, and Physics of Solids. Author (TAB)

N68-20817# Catholic Univ. of America, Washington, D. C. Dept. of Mechanical Engineering.
AN ANALYSIS AND DESIGN OF A LINEAR GUARDED CUT-BAR APPARATUS FOR THERMAL CONDUCTIVITY MEASUREMENTS
David A. Didion 31 Jan. 1968 71 p refs
(Contract Nonr-2249(12))
(TR-2; AD-665789)

A quantitative analysis of the Cut-Bar method of measuring the thermal conductivity of solids is performed. The mathematical model, which corrects for the difference in heat flux in the specimen and reference standard, is that of the two dimensional steady heat conduction equation applied to an annulus of insulation. The solution is presented in detail and found to be comprised of two physically distinct parts, a conductivity factor and a geometrical factor. A number of charts and graphs are presented for clarification as to the nature and magnitude the relative sizes of the various components will have on the accuracy over different conductivity ranges. The complexity of the geometrical factor required digital computer programs which are included. Reference is made to a similar study, performed by researchers at the National Bureau of Standards. It is found that the differences in the guard temperature distribution results in a substantial change in the geometrical factor. Author (TAB)

N68-20836# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF FUSING-IN TIN IN GALLIUM ARSENIDE [K VOPROSU O VPLAVLENII OLOVA V ARSENID GALLIYA]
L. D. Libov and S. S. Meskin 23 Aug. 1967 16 p refs
Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), no. 3, 1965 p 86–92
(FTD-HT-66-557; AD-665705)

The starting materials for the tests were: polycrystalline gallium arsenide and OSCh-00 tin. Before weighing, the gallium arsenide samples were polished with electrocorundum powder and cleansed in a solution of sodium hydroxide and hydrogen peroxide. The weight of the gallium arsenide samples varied from 4 to 8 grams. At the end of the holding time the sample of gallium arsenide was removed quickly from the molten tin and cleansed in

hydrochloric acid, in which gallium arsenide is practically insoluble. Several experiments were made at each set of temperature conditions. The tests lasted from three to eighteen hours and equilibrium conditions set in after 9-12 hours. The experimental data obtained by the weight and drop methods are exhibited in the form of sections of the liquidus curves for the system Sn-GaAs in the temperature interval 400-800C. The phase structure was determined by an X-ray method. The liquidus lines and a knowledge of the distribution coefficient of tin at the melting temperature of gallium arsenide made it possible to calculate the specific fusibility of tin into solid gallium arsenide in the temperature range 400-800C. TAB

N68-20848# Illinois Univ., Urbana.
THEORY OF ELECTRON TRANSPORT PROCESSES IN TUNNEL DIODES
Michael Faiman (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-6605

A unified theory of conduction processes in tunnel diodes is presented. The use of Fermi-Dirac distributions in nonequilibrium tunneling integrals is justified. The direct tunneling mechanism is examined from two points of view and is shown to be described about equally well by either. In subsequent sections, indirect tunneling and the phenomena of excess and thermal currents are treated. Dissert. Abstr.

N68-20920# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
HIGH DENSITY ELECTRON HOLE GAS IN SEMICONDUCTORS, 1
S. B. Anokhin, E. I. Butikov, A. S. Kondrat'ev, and V. P. Makarov 16 Jan. 1968 14 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Fiz. i Khim. (Leningrad), no. 4, 1967 p 36–41
(Contract NOw-62-0604-c)
(APL-TG-230-T540; AD-665595)

The high-density electron-hole gas present in semiconductors is considered at T = 0 using the Green function method. The correlation energy is evaluated up to non-vanishing terms as r sub e approaches zero. Author (TAB)

N68-20930# California Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECT OF TERNARY ADDITIONS ON THE SUPERCONDUCTING PROPERTIES OF $NbAl_3$
Larry Dowd Hartsough (M.S. Thesis) Dec. 1967 25 p refs
(Contract W-7405-ENG-48)
(UCRL-17982) CFSTI: HC $3.00/MF $0.65

The J_c vs H characteristics of Nb_2Al, with T_c of 16.8°K, were compared with those of an alloy of nominal composition $Nb_3(Al_{0.8}Ge_{0.2})$, with T_c of 18.7°K. A substantial improvement for the latter was found. The effect on T_c of As additions to Nb_3Al was considered but it was found that the solubility is less than two atomic percent. The recently-reported high T_c (20.05°K) for well-ordered $Nb_3(Al_{0.8}Ge_{0.2})$ leads to the consideration of the effect of Ge additions to Nb_3Al on its upper critical field H_{c2}. A prediction of an increase in H_{c2} was borne out by the results obtained using pulsed magnetic fields. It was predicted that the steady-field J_c vs H properties may show better conductive properties under steady-field conditions. It is contended that the addition of As to Nb_3Al will improve the stoichiometry (hence the T_c) of the latter without affecting its electron/atom ratio or electron density. Unfortunately, the solubility of As in Nb_3Al is too low to test the prediction. Author (NSA)

N68-21028*# Battelle Memorial Inst., Columbus, Ohio. Electronics Research Center.
HIGH-TEMPERATURE-MATERIALS STUDY
R. D. Baxter, E. P. Stambaugh, and F. J. Reid Jan. 1968 36 p refs
(Contract NAS12-107)
(NASA-CR-86043) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Techniques were developed for the chemical vapor deposition of aluminum phosphide (AlP) onto single crystals of Si and GaAs at substrate temperatures in the range 650°–1200°C. For deposition at substrate temperatures above 950°C, All and PH_3 were reacted in an essentially all-ceramic reactor system, designed and built in the course of this program. Epitaxial layers up to 600 microns thick were grown on silicon substrates at 1120°C in a temperature gradient of about 10 deg/cm for a phosphorus-to-aluminum ratio less than unity. Spectrographic analyses indicated that the improved electrical properties were associated with reduced concentrations of chemical impurities, particularly silicon and copper, and identified silicon as the major donor impurity. Specimens of AlP prepared in the ceramic reactor were used for exploratory studies on p–n junction formation and device fabrication. The feasibility of producing AlP of still lower silicon content by (1) deposition at substrate temperatures below 950°C and (2) use of induction heating of the substrates (to maintain the reactor walls at a relatively low temperature) was investigated employing the reagent systems PH_3–$AlCl_3$ and Al–PCl_3. Crystalline AlP was deposited as layers onto GaAs, silicon, and tantalum by the PH_3–$AlCl_3$ reaction at substrate temperatures as low as 650°C. It is concluded, on the basis of the results of the rather modest effort expended thus far, that AlP shows excellent potential for development as a material for devices with superior high-temperature characteristics. Author

N68-21044 Pittsburgh Univ., Pa.
AN ANALYSIS OF TOTAL LOSSES IN FERROMAGNETIC MATERIALS AND A MODEL OF FERROMAGNETIC DOMAIN INTERACTIONS
Marshall David Abrams (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4139

The objective of this investigation is to study hysteresis phenomena and its effects on losses in solid ferromagnetic materials. An essentially exact analysis of eddy current and hysteresis losses is conducted. Two particular geometries, the infinite flat plate and the infinite cylindrical rod, are considered. Starting from basic principles, the physical equations relating induced current density and magnetic flux density as a function of time and space are developed in finite difference form and programmed on an IBM 7090 digital computer. The theoretically calculated losses obtained from this program are compared with experimentally measured losses, and with losses calculated employing the assumption of no hysteresis. It is believed that the procedure described represents a major contribution to the literature of loss analysis. To better explain and understand the physical mechanism of magnetic hysteresis, a model representative of ferromagnetic materials is developed employing the domain as the basic building block. Dissert. Abstr.

N68-21045 California Univ., Riverside.
OPTICAL AND TRANSPORT PROPERTIES OF α-MnS
Donald Ray Huffman (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-5851

Excellent crystals of α-MnS have been grown and their electrical and optical properties studied. The following objectives have been pursued: (1) to determine the electron energy band structure; (2) to measure the electrical and optical constants required for theoretical treatments; (3) to determine the conduction mechanism; and (4) to discover the changes that occur near the Neél temperature. Reflectance through the Restrahl region has been measured on a polished powder sample from 80 μ to 20 μ. Optical absorption has been measured from room temperature to helium temperatures between the Restrahl region and the intrinsic absorption region in the ultraviolet. Room temperature reflectance

measurements from 6000 Å to 800 Å have been analyzed by the Kramers–Kronig technique to extend the determination of optical constants into the opaque region. Electrical conductivity and Seebeck coefficient measurements have been made as a function of temperature, and specific heat values have been measured in the vicinity of the Neél temperature. Dissert. Abstr.

N68-21135# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

STUDY OF THE EFFECT OF THE ENERGY SPECTRUM AND OF THE TOTAL FLUX ON THE DAMAGE PRODUCED BY NEUTRONS IN SOLIDS [CONTRIBUTION A L'ETUDE DE L'INFLUENCE DU SPECTRE ET DU FLUX INTEGRE SUR LES DOMMAGES CREES PAR LES NEUTRONS DANS LES SOLIDES]

Pierre Claude Dulieu (Ph.D. Thesis) 1967 62 p refs In FRENCH
(CEA-R-3228)

The general relation between the physical effects produced by neutrons in solids, and the total flux and neutron energy spectrum was studied. Some examples are given. A silicon damage detector whose function is to use the damage produced in a PIN junction for measuring the neutron flux (intermediate and fast) received by the detector was also studied. The energy given to the atoms by a primary in the silicon was determined experimentally. The results and conclusions drawn from this determination made it possible to consider the calculation of the detectors response characteristics. The detectors response function was measured, and it is noted that good agreement was obtained between the calculation and experimental results. Author (NSA)

N68-21212*# University of Southern Calif., Los Angeles. Dept. of Physics.

OPTICAL AND PHOTOELECTRIC PROPERTIES INCLUDING POLARIZATION EFFECTS, OF GOLD AND ALUMINUM IN THE EXTREME ULTRAVIOLET Technical Report, Jan. 1965–Jan. 1968

Arthur L. Morse 5 Jan. 1968 116 p refs
(Contract NsG-178-61)
(NASA-CR-93971; USC-VACUV-109) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Thin films of gold and aluminum were investigated in the spectral region of 100 to 1000 Å, stressing the effects of polarization and angle of incidence on total yield and energy distribution of the photoelectrons. The reflectance was used in conjunction with Fresnel relations to calculate the optical constants and polarization of the incident beam. Polarization was verified by direct measurement, reflectance by measuring at several angles of incidence, with the plane rotated 90°. Optical constants and polarization data were then used to predict the original reflectance curves. Total yield data and photoelectron energy distributions were obtained with a spherical retarding potential system and an electron multiplier, respectively. It was found that the variation of photoelectric yield with angle of incidence depends primarily on the absorption depth of the photons. The effect of the direction of polarization relative to the plane of incidence was small and could only be seen in terms of the yield of low energy photoelectrons. K.W.

N68-21219*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RADIATION DAMAGE IN THICK COPPER AND GOLD SPECIMENS PRODUCED BY LOW-ENERGY PROTONS

Howard F. Savage and Robert D. Morris Washington Apr. 1968 12 p refs
(NASA-TN-D-4452) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The production of defects at 90°K in thick gold and copper foils by 50 to 400 keV protons and subsequent annealing characteristics of these metals have been studied. The thickness of the specimens was several times the calculated range of the protons. The defects formed in gold were uniformly distributed along the proton range, whereas the defects formed in copper were more than twice as dense toward the end of the range as at the beginning. At doses from 10^{15} protons/cm^2 to at least the maximum of the tests, the change in electrical resistivity of both the gold and copper at incident energies between 50 and 400 keV can be decribed by a relation of the form $\Delta\rho = A\phi^n$, where $\Delta\rho$ is the increase in resistivity and ϕ is the dose. The recovery of gold upon isochronal annealing was similar to that observed for high-energy irradiations of thin specimens. Author

N68-21249# General Electric Co., Schenectady, N. Y. Research and Development Center.

INTRODUCTORY NOTES ON THE EFFECTS OF STRAIN, APPLIED ELECTRIC FIELD AND JAHN–TELLER EFFECTS IN PARAMAGNETIC RESONANCE

F. S. Ham Aug. 1967 80 p refs
(Rept.-67-C-315)

These notes provide an introduction to effects of applied strain, applied electric fields, and Jahn–Teller effects in electron paramagnetic resonance of defects in crystals. The emphasis is on the way these perturbations modify the spin Hamiltonian of the defect. The changes in the g- and D-tensors with static macroscopic strain are given in terms of phenomenological strain coupling coefficients. The limitations imposed upon these coefficients by the point group symmetry of the defect are analyzed by means of group theory. This treatment is then extended to the effect on the spin Hamiltonian of generalized distortions of the crystalline environment, and to the linear effect of an applied electric field. Using these results to obtain the form of Jahn–Teller coupling in various cases, both static and dynamic Jahn–Teller effects are described for orbital triplet states and orbital doublet states. Illustrative examples of Jahn–Teller effects in paramagnetic resonance are given from the results of recent research. Author

N68-21250# Northrop Corp., Hawthorne, Calif.

RADIATION EFFECTS IN SILICON AND GERMANIUM

O. L. Curtis, Jr., F. F. Bass, and C. A. Germano Washington HDL Nov. 1967 161 p refs
(Contract DA-49-186-AMC-235(X))
(NCL-67-63R; HDL-235-3; AD-660220)

The following have been studied and reported: (a) the influence of aluminum on carrier degradation in neutron-irradiated silicon. (b) dependence of carrier lifetime on excess density for neutron-irradiated silicon. (c) influence of impurities on carrier removal and annealing in neutron-irradiated silicon in the resistivity range from 0.5 to 50 ohm-cm. (d) recombination level position from the dependence of lifetime on excess density in n-type germanium following irradiation. (e) short-term annealing in bulk silicon following pulsed neutron irradiation. (f) carrier recombination at disordered regions in neutron-irradiated semiconductors.
Author (TAB)

N68-21292*# Naval Weapons Center, China Lake, Calif.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE PHYSICS OF CRYSTALLINE SURFACES Annual Report, 1 Feb. 1967–31 Jan. 1968

E. Bauer 31 Jan. 1968 6 p refs
(NASA Order R-05-030-001)
(NASA-CR-94082) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Relation between structure of epitaxial films and surface and of interfacial energies was studied, and the evolution of water from alkali halides was investigated. Quantitative studies were made of the elastic and inelastic interactions of slow electrons with tungsten single crystal surfaces, as well as of the nature and structure of surface layers with low energy electron diffraction. Relation between structure and electron emission properties was determined for work function reducing layers on tungsten (110) planes. Other studies dealt with momentum exchange of atoms on well defined single crystal surfaces and the theory of low energy electron scattering. M.W.R.

N68-21302# Cornell Univ., Ithaca, N. Y. Materials Science Center.
MATERIALS SCIENCE CENTER ANNUAL TECHNICAL REPORT, 1 JULY 1966–30 JUNE 1967
31 Aug. 1967 196 p refs
(Contract ARPA SD-68)
(Rept.-770; AD-659196)

Summaries are given of the objectives and progress of a broad spectrum of basic studies on the chemical, physical, electrical, and engineering properties of materials. Each project summary is accompanied by a list of publications generated as a result of that project. TAB N

N68-21320# Istituto Elettrotecnico Nazionale (Galileo Ferraris), Turin (Italy).
ON THE CRYSTAL DEFECTS THAT CAUSE AC ELECTROLUMINESCENCE Final Scientific Report
Guido Bonfiglioli and Piero Brovetto Oct. 1967 18 p refs
(Grant AF-EOAR-66-27)
(AFOSR-68-0474; AD-666465)

The present Note is intended as a preliminary description of the geometry and, at some extent, also of the conduction properties of a linear shaped, truncated crystal defect that is peculiar of those structures that may exhibit polytypism. The presence of such defects, in the writers opinion, constitutes the cause of the ac Electroluminescence (Destriau effect). On these grounds all the peculiar features of the EL patterns can be interpreted - as well as other aspects of the phenomenon that were, so far, only poorly understood. A brief discussion of these topics is offered. Author (TAB)

N68-21407# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
HIGH FREQUENCY EFFECTS IN JOSEPHSON JUNCTIONS [PHENOMENES HAUTE FREQUENCE DANS LES JONCTIONS DE JOSEPHSON]
Jacques Lasry (Ph.D. Thesis) Dec. 1967 30 p refs In FRENCH
(CEA-BIB-113)

A Josephson junction consists of two superconductors separated by a thin insulating layer. When a constant voltage is applied across such a junction, under some conditions, a very high-frequency electromagnetic radiation emanates from the gap, indicating the presence in the gap of a current of frequency $\nu = 2eV_0/h$, called the ac Josephson current. The equations describing this effect are briefly analyzed. Some experiments are then described: first, the experiments which provide indirect evidence for the existence of the ac Josephson effect, starting from the structure of the junction dc current–voltage characteristic, and second, the experiments which provide direct observation of the ac Josephson effect. Author (NSA)

N68-21409# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
VULNERABILITY EFFECTS IN BULK-SOLIDS, VOLUME 1 Final Technical Report, 1 Nov. 1966–30 Sep. 1967
L. F. Eastman Griffiss AFB, N. Y. RADC Jan. 1968 133 p refs
(Contract F30602-67-C-0075)
(RADC-TR-67-646, V. 1; AD-666034)

Intrinsic characteristics of Gunn diodes, avalanche diodes, and bulk effects in magnetized InSb were studied for methods and techniques of enhancing electromagnetic compatibility in applications of these devices. Gunn domain mode oscillators were studied for their harmonic outputs and spectral content. 15 GHz oscillators were found to have high harmonic content even to the tenth harmonic, and heat sinking of the diodes was undertaken to allow measurements over a range of duty cycles up to continuous operation. Negative conductivity GaAs devices with low NeL (electron density-sample length) product in appropriate circuits were studied and linear amplification was obtained up to an efficiency of a few percent; thus, low harmonic content is indicated. Helicon resonances in InSb at 77 degrees K were studied to evaluate the capabilities of electronically tunable filters and non-reciprocal devices. Author (TAB)

N68-21433*# Texas Univ., Austin. Electronic Materials Research Lab.
RESEARCH ON DIGITAL TRANSDUCER PRINCIPLES Semiannual Report, 1 Jul.–31 Dec. 1967
William H. Hartwig 31 Dec. 1967 65 p refs
(Grant NGR-44-012-043)
(NASA-CR-94086; SAR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20L

A deeper understanding of metal–polymer–silicon structures is given, and the necessary materials properties for the sharp discontinuity in conductivity of MPS devices are described. The polymer itself is exhaustively studied and its role in development of digital MIS transducers is discussed. Additional progress was made in exotic dielectrics to use as active transducer material in MIS structures. Titanium dioxide has been successfully deposited from a chemical vapor. Properties of titanium dioxide films are given as the results of preliminary measurements. A parallel study on silver-doped cadmium–sulphide revealed a new kind of photodielectric response which produces a frequency change proportional to the integral of light intensity. Author

N68-21483# Stanford Univ., Calif. Solid-State Electronics Lab.
PROPERTIES OF ION-IMPLANTED BORON, NITROGEN, AND PHOSPHORUS IN SINGLE-CRYSTAL SILICON
Walter J. Kleinfelder Mar. 1967 145 p refs
(Contract ARPA SD-87)
(SU-SEL-67-015; K701-1; AD-665965)

The technique of ion implantation provides a method of introducing impurities into semiconductors for the purpose of selectively doping the material to form device structures. The purpose of the research reported here was to investigate the usefulness of this technique for implanting the elements boron, phosphorus, and nitrogen into the semiconductor silicon. The material produced by this method was analyzed in relation to both its physical properties and to the electrical characteristics of the device structures obtained. Planar and mesa diodes were fabricated which had low leakage and sharp reverse breakdown characteristics. Also by ion implantation methods, useful planar transistors were made which exhibited common-emitter current gains up to 30. Author (TAB)

N68-21496# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
VULNERABILITY EFFECTS IN BULK-SOLIDS, VOLUME 2: OPERATION OF GUNN DEVICES IN A SERIES D-C BIAS CONFIGURATION Final Report, 1 Nov. 1966–30 Sep. 1967
John William Monroe Griffiss AFB, N. Y. RADC Jan. 1968 70 p refs
(Contract F30602-67-C-0075)
(RADC-TR-67-646, V. 2; AD-666035)

Operation of Gunn devices in a series d-c arrangement is discussed. Theoretical arguments show that series operation, if attainable, can result in higher-quality microwave output signals and greater efficiency of operation resulting from an increase in r-f output power available from the series device. Three different experimental circuits were employed in the effort to obtain series device operation. The most successful circuit turned out to be a strip-line resonator with a Qo of 7.9 at 1.8 GHz. Series Gunn devices operated in this circuit delivered five times more microwave power than single devices operated in the same circuit. Efficiency increased correspondingly, although only a slight improvement in signal quality was noted. The series oscillation seems to be the result of a push-pull type of operation in the strip-line resonator. Push-pull operation should lead to cleaner r-f signals by suppressing even harmonics of the oscillation, but the electric fields necessary to cause series operation are so high that some impact ionization occurs, detracting from the signal quality. Author (TAB)

N68-21517# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nationali.
TECHNOLOGY OF SOME SUPERCONDUCTIVE MATERIALS FOR HIGH MAGNETIC FIELDS [TECNOLOGIA DEI MATERALI SUPPERCONDUTTORI PER ELEVATI CAMPI MAGNETICI]
29 Feb. 1968 23 p refs In ITALIAN
(LNF-68/7) CFSTI: HC $3.00/MF $0.65

Reactions of superconductive solenoids in an intense electromagnetic field are classified in three types: (1) characterized by complete expulsion of the magnetic flux, or very limited penetration; (2) characterized as showing the Meissner effect; and (3) characterized by strong irreversible magnetic field. The critical temperature, critical magnetic field, flux density, and flux limits are graphed for various compounds of niobium, zinc, gallium, and silicon. Techniques of producing niobium tin by sintering, chlorination, and diffusion are presented. Transl. by F.S.

N68-21533# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
POSITRON ANNIHILATION IN METALS Final Scientific Report, 1 Jan. 1965–30 Sep. 1967
Ronald D. Parks Feb. 1968 3 p refs
(Grant AF-AFOSR-807-65)
(AFOSR-68-0318; AD-666453)

A brief summary is presented involving the study metals by the positron annihilation technique. The most significant accomplishment was the demonstration that the positron annihilation technique is capable of yielding information about the band structure of ferromagnetic transition metals. Additional studies demonstrated the effect of ferromagnetic materials on adjacent superconducting films and provided the first information about the behavior of superconductors in the presence of large magnetic exchange fields. TAB

N68-21568# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
VULNERABILITY EFFECTS IN BULK-SOLIDS. VOLUME 3: AN AVALANCHE DIODE ACTIVE MICROWAVE MIXER Final Report, 1 Nov. 1966–30 Sep. 1967
A. Sweet Griffiss AFB, N. Y., RADC Jan. 1968 66 p refs
(Contract F30602-67-C-0075)
(RADC-TR-67-646, V. 3; AD-666036)

An avalanche diode is proposed as a microwave mixer. In addition to providing its own local oscillator, the diode may amplify the input signal, and the I.F. output. These amplifications could result in conversion gain. Best experimental result was 4 db conversion loss and a noise figure of 65 db at I.F. = 40 MHz. The diode was operated in a standard medium Q microwave circuit. A special high Q microwave circuit was constructed to reduce the noise figure. Mixer operation with this circuit yielded conversion gain as high as 28 db and a noise figure of 45 db. It is shown that conversion gain is a result of negative I.F. resistance, which is only associated with high Q operation. The diodes I.F. impedance has been measured. The frequency pulling, and spectral noise associated with various microwave circuits has been studied. Author (TAB)

N68-21570# Parke Mathematical Labs., Inc., Carlisle, Mass.
RESEARCH ON RADIATION EFFECTS IN SOLIDS Final Scientific Report, Jan. 1963–Dec. 1967
Dec. 1967 18 p
(Contract AF 19(628)-2419)
(AFCRL-68-0019; Rept.-2419-F; AD-666040)

Contents: Radiation effects in solids - atomic displacement effects; Radiation effects in solids - secondary electron emission; Purification methods; and Statistical analysis of data. TAB

N68-21573# Picatinny Aresnal, Dover, N. J. Engineering Sciences Lab.
THE BAND-GAP PHOTOCONDUCTIVITY OF HIGH-PURITY SINGLE CRYSTALS OF CUBIC (BETA) SILICON CARBIDE
John A. Detrio Feb. 1968 35 p refs
(PA-TM-1775; AD-666210)

The report presents band gap photoconductivity data on beta phase silicon carbide. The data was compared with first order optical theory and found to provide essential agreement. Author (TAB)

N68-21603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENERGY SPECTRA OF SLOW IONS EMITTED BY A METAL SURFACE AS A RESULT OF ION BOMBARDMENT
U. A. Arifov and D. D. Gruich 7 Aug. 1967 11 p Transl. into ENGLISH from Akad. Nauk Uz. SSR, Dokl., no. 5, 1965 p 20–23
(FTD-HT-23-799-67; AD-666243)

Energy spectra of slow Cs(+) ions emerging from pure cold and hot Ni(-), Mo(-), and W(-) targets were studied by means of a 127 degree cylindrical capacitor with a resolution delta E = 0.5 eV. The secondary ions were analyzed at an angle of 135 degrees with respect to the direction of the primary Cs(+) ions which fell on the target normally. Thermionic-emission and slow-ion peaks are resolved in the spectra. The slow-ion spectrum width is independent of the target temperature; however, it increases in the same order as the atom bond energies in the Ni(-), Mo(-), and W(-) targets. With the experimental spectra plotted in semilogarithmic scale, their right-of-maximum branches well register with the straight lines whose slopes are in the same order. This permits presuming that the slow ions acquire their energy from intense oscillation of atoms in that target section which is excited by the ion bombardment. Author (TAB)

N68-21607# Tyco Labs., Inc., Waltham, Mass.
INVESTIGATION OF EVAPORATION AND CONDENSATION MECHANISM Final Report, 15 May 1966–31 Aug. 1967
F. H. Cocks, B. N. Das, C. B. Lamport, A. A. Menna, E. A. Trickett et al Dec. 1967 149 p refs
(Contract AF 33(615)-5060)
(AFML-TR-67-385; AD-666073)

For most materials the condensation coefficient alpha is available and provides a fair estimate of the rate of evaporation and vapor-phase growth of thin films or bulk crystals. However, little information exists on the detailed kinetics of the evaporation or condensation itself. Also, little attention has been paid to the fact that alpha may assume different values for different planes of the same crystal. Instead of attempting to obtain and interpret the mean value of alpha, a new approach is followed here which utilizes the changes in the growth or solution rates of specific crystal planes as a function of varying growth or evaporation conditions. Since a given crystal plane is made up of easily identifiable atomic surface sites (representing the kinetically rate-determining participants in the atomic process taking place on this plane), the type of observed crystal morphology then serves to identify these processes. The evaporation and growth (both directly from the vapor and by chemical decomposition) of ZnO has been selected for study as a model process. Guidelines for the evaluation of experimental morphology data and the derivation of theoretical crystal morphology are described. It was found that habits of various crystal structures can be expressed by a structure factor type formula. Author (TAB)

N68-21627# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FERROMAGNETIC RESONANCE AND THE FARADAY EFFECT IN SOME FERRITES WITH A SPINEL AND GARNET STRUCTURE [FERROMAGNITNYY REZONANS I EFFEKT FARADEYA V NEKOTORYKH FERRITAKH SO STRUKTUROY SHPINELI I GRANATA]

V. F. Belov and A. M. Nechushkin 29 Aug. 1967 9 p refs Transl. into ENGLISH from Tr. Mosk. Inst. Neftekhimicheskoi i Gaz. Prom. (USSR), no. 52, 1964 p 133–135
(FTD-HT-67-165; AD-666146)

The authors studied the ferromagnetic resonance and the Faraday effect in ferrite-spinel and ferrite-garnet monocrystals at 8300 Mc. The chemical composition of the various spinels and garnets used is given together with the measured data concerning the saturation magnetization, g-factor, magnetic anisotropy constant, width of the ferromagnetic resonance line (as a function of crystal orientation), and specific polarization plane rotation angle (as a function of the applied magnetic field). TAB

N68-21632# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
NONLINEAR OPTICAL SUSCEPTIBILITIES IN GROUP 4 AND 3–5 SEMICONDUCTORS
Sudhanshu S. Jha and N. Bloembergen Jan. 1968 54 p refs
(Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(TR-550; AD-665983)

The contribution of the valence electrons to the nonlinear optical susceptibilities may be estimated on the basis of simple tetrahedral bonding orbitals. The coefficient for second harmonic generation in III-V compounds is in satisfactory agreement with the theoretical estimate. The same model contributes to the third-order nonlinearity, which describes scattering processes between four light waves. Again reasonable agreement is obtained with data for combination frequency generation in Si and Ge. The much larger effects in n-type InAs and InSb are due to conduction electrons. Their contribution has been calculated exactly if Kanes theory for the band structure is used. The contribution of the valence electrons is, however, not negligible and is equal to the contribution of 10 to the 16th power electrons/cc in InSb. Author (TAB)

N68-21644# Fairchild Semiconductor Corp., Mountain View, Calif.
RADIATION STUDY ON MOS STRUCTURES Interim Scientific Report
E. H. Snow and D. J. Fitzgerald Jan. 1968 65 p refs
(Contract AF 19(628)-5747)
(AFCRL-68-0045; SR-4; AD-666435)

Two effects of ionizing radiation on oxidized silicon surfaces have previously been reported: the formation of a space charge in the oxide and the creation of surface states at the oxide-silicon interface. In this report, the effects of processing variables -- including substrate type, oxidation conditions, gettering and annealing steps, and the use of silicon nitride in place of silicon dioxide -- on the above two phenomena are described. It is found that all oxide devices are very sensitive to ionizing radiation. Nitride devices are relatively unaffected by ionizing radiation, but they possess a high field trapping instability which makes them unacceptable for the gate dielectric of an MOS transistor. Experiments with nuclear reactor irradiation show that in a reactor environment bulk damage due to fast neutrons dominates in the degradation of bipolar transistors, junction field-effect transistors, and p-n junction diodes, whereas, surface effects due to ionizing radiation also present in the reactor are most important in the case of MOS transistors. Author (TAB)

N68-21664# Michigan Univ., Ann Arbor.
SOME EARLY LEAD SALT DETECTOR DEVELOPMENTS Final Scientific Report
D. J. Lovell [1967] 84 p refs
(Contract F44620-67-C-0051)
(Rept.-8600-3-J; AFOSR-68-0264; AD-666031)

The report describes the history of the early research and development that was accomplished in the area of lead salt cells, a device for detecting the presence of infrared radiation. The time span covered is World War II and the period immediately following. The efforts of industries, universities, and foreign countries are discussed; however, the pioneering work of Robert J. Cashman is emphasized. The report is a case history of the development of a science into technology showing some of the mechanisms by which science is advanced. Included in the report is a comprehensive bibliography of the subject. Author (TAB)

N68-21689# Cornell Univ., Ithaca, N. Y. Materials Science Center.
OPTICAL AND ELECTRON SPIN RESONANCE STUDIES OF THE ICL $^{-}V_K$ CENTER IN KCl:I
Lawrence S. Goldberg and Marvin L. Meistrich 29 Feb. 1968 60 p refs
(Contracts Nonr-401(54); Nonr-401(47))
(Rept.-901; AD-665980)

The ICl(-)V-K center, a <110>-oriented self-trapped hole center, was investigated in X-irradiated KCl:I and KCl:I:Pb at low temperatures by optical and electron spin resonance techniques. Three optical transitions are identified at 430, 840, and 1000 nm by anisotropic absorption measurements; their observed sigma polarizations and relative intensities are consistent with a molecular-orbital model modified for XY(-) molecule-ion centers. Pulse annealing experiments monitored by ESR and correlated with thermoluminescence data and absorption spectrum changes give information on the formation and thermal stability of ICl(-). An improved analysis of the ESR spectrum has been carried out taking into account deviations from axial symmetry. Calculations of the large iodine quadrupole interaction are extended to second-order perturbation theory, and observed forbidden transitions are fitted to these equations, allowing a determination of the sign, as well as the magnitude, of the quadrupole interaction. Author (TAB)

N68-21690# Harvard Univ., Cambridge, Mass.
[DIVISION OF ENGINEERING AND APPLIED PHYSICS] Final Report
D. Turnbull Feb. 1968 29 p refs
(Contract Nonr-1866(50))
(TR-16; AD-666584)

Brief summary of research previously reported. Contents: Crystal growth in ceramic glass forming systems; Phase separation in silicate glasses; New packing of uniform spheres; Small angle scattering by a crystallite model of amorphous materials; Amorphous alloys and semiconductors; Interstitial defects in polyvalent metals; Hot-stage for x-ray diffraction of ceramic systems. TAB

N68-21696# Columbia Univ., New York. School of Engineering and Applied Science.
INTERNAL FRICTION STUDIES IN NICKEL CRYSTALS FROM 77°K–298°K
Peruvemba S. Venkatesan (Ph.D. Thesis) 10 Jan. 1968 190 p refs
(Contract Nonr-266(61))
(TR-9; AD-666572)

The internal friction spectrum in nickel single crystals has been studied near 20 kHz from 77 degrees K to 298 degrees K as a function of the stages of deformation, crystal orientation, temperature of deformation, magnetic field and state of annealing. TAB

N68-21708*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECTRAL EMISSIVITY OF HIGHLY DOPED SILICON
Curt H. Liebert and Ralph D. Thomas Washington Apr. 1968 26 p refs
(NASA-TN-D-4303) CFSTI: HC$3.00/MF$0.65 CSCL 20L

Measurements were made at temperatures of 300°, 882°, and 1074°K of the normal spectral emissivity of opaque, highly doped silicon. The silicon was doped with arsenic and boron to electron carrier concentrations of 2.2×10^{19}, 3.7×10^{19}, and 8.5×10^{19} electrons per cubic centimeter and hole carrier concentrations of 6.2×10^{19} and 1.4×10^{20} holes per cubic centimeter. The 300°K emissivity data were obtained at wavelengths

from 2.5 to 35 microns. The high temperature emissivities were measured from 3.5 to 14.8 microns. Carrier concentrations and direct current resistivity of the silicon were also measured. The carrier concentrations were determined from Hall measurements made at 300°K. The direct current resistivity was measured at temperatures from 300° to 1200°K. These quantities were used in analytical calculations of the emissivities. Agreement of the Hagan–Rubens theory with experiment was found at wavelengths greater than 12 microns and at 300°K. Good agreement of the free carrier absorption theory with experiment was achieved at all wavelengths and temperatures investigated. The free carrier absorption theory predicts the emissivity in terms of the index of refraction and the absorption index. The values of these quantities are presented. A comparison of the values of the absorption index obtained with those obtained from the literature showed good qualitative agreement. Author

N68-21714# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF CERTAIN PHENOMENA IN A PARAMAGNETIC SUBSTANCE THAT ARE DEPENDENT ON THE SPIN PHONON INTERACTION [K TEORII NEKOTORYKH YAVLENIY V PARAMAGNETIKE, OBUSLOVLENNYKH SPIN-FONONNYM VZAIMODEYSTVIYEM]
B. I. Kochelayev 25 Aug. 1967 33 p refs Transl. into ENGLISH from the Publ. "Paramagnitnyi Rezonans" (USSR) 1964 p 78–97
(FTD-HT-66-567; AD-665707)

A theoretical explanation is given for the following paramagnetic phenomena caused by spin-phonon interaction: (1) absorption of the energy of an alternating magnetic field parallel to a constant field; (2) absorption of acoustic energy in a paramagnetic substance due to the interaction of spins with each other and with thermal phonon; (3) rotation in the plane of polarization of a cross-polarized acoustic wave during passage through a paramagnetic crystal; (4) interaction of spins through the phonon field; (5) electron paramagnetic resonance saturation. TAB

N68-21717# Naval Research Lab., Washington, D. C.
SECOND HARMONIC GENERATION BY REFLECTION FROM GaAs Interim Report
James B. Langworthy 19 Jan. 1968 51 p refs
(ARPA Order 660)
(NRL-6662; AD-666107)

The intensity of second harmonic light generated by reflection from a Gallium Arsenide Crystal is calculated in detail in four cases of polarization. Relevant properties of GaAs are stated and an experiment is described. Based on this, constitutive relations are written in the weak field approximation and the second and third order material tensors are reduced using crystal symmetry. The nonlinear wave equation is solved in the parametric approximation when phase matching is not present. The boundary value problems for the fundamental entering the medium and for the second harmonic leaving are solved. The only significant null solution is found to be the Brewsters angle extinction. Some numerical exploration of the exact effects of absorption at both fundamental and second harmonic are made. They are found to be small and are negligible for qualitative purposes unless the imaginary part of the dielectric constant exceeds the real part. Variation of intensity with crystal orientation is described in detail. The occurrence of phase matching as a null solution of the wave equation is seen to offer a natural approach to the problem of obtaining the geometry of phase matching for the most general optical medium. Author (TAB)

N68-21769# Norwegian Defence Research Establishment, Kjeller.
ACOUSTOELECTRIC EFFECTS IN SOLIDS Progress Report, 1 Apr. 1966–31 Mar. 1967
Andreas Rannestad 20 Jun. 1967 7 p refs
(Contract AF 61(052)-958)
(PR-4; AFCRL-67-0636; AD-666452)

The report gives a brief summary of the investigations undertaken in the period 1 April 1966 - 31 March 1967, and is concerned with the acoustoelectric effects in solids. Particular emphasis has been placed on acoustoelectric saturation and current oscillations in CdS and ZnO and electrical field distribution in CdS. Author (TAB)

N68-21775# Technische Hochschule Munchen (West Germany). Physikdepartment.
STUDY OF TRAPPING PROPERTIES AND IR STIMULABILITY OF ZINC SULPHIDE
G. Baur and P. Thoma Wright-Patterson AFB, Ohio ARL Dec. 1967 48 p refs Presented at the Seminar, Wright-Patterson AFB, Ohio, 3 Mar. 1967
(Contracts AF 33(615)-2272; T-598-I-203)
(ARL-67-0277; AD-666075)

The infrared stimulability of 4 different types of ZnS phosphors is investigated at low temperatures in the wavelength range between 2 and 11 micro meters. It is found that the stimulability depends on the occupation of a quasi-continuum of very shallow electron traps. The release process of these traps is shown to be a tunnel process. The method of space charge limited currents for detecting traps and trap distributions is discussed. Author (TAB)

N68-21806 Rutgers Univ., New Brunswick, N. J.
QUANTUM OSCILLATIONS IN HELICON PROPAGATION IN TIN
Dan Andrew Hays (Ph.D. Thesis) 1966 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-5265

Results are presented of a study of helicon wave propagation in crystals of β tin. Helicon propagation was studied by measuring the mutual inductance of crossed coils wound around a plate sample of dimensions $10 \times 10 \times (1.00 \pm 0.02)$ mm^3. The primary (which produces the helicon) was connected to an audio oscillator, and the secondary (which detects the helicon) was connected to a preamplifier and VTVM. A rotation of the magnetic field away from the [001] direction ($\approx \pm$ 5 degrees) resulted in the helicon propagation being strongly damped by aperiodic open orbits. Rotation curves for which the magnetic field does not pass through the [001] direction display effects due to periodic open orbits in the (100) and (110) planes. Dissert. Abstr.

N68-21822# Joint Publications Research Service, Washington, D. C.
ELECTRICAL AND PHOTOELECTRIC PROPERTIES OF ORGANIC POLYMER SEMICONDUCTORS
V. S. Myl'nikov 17 Apr. 1968 32 p Transl. into ENGLISH from Usp. Khim. (Moscow), v. 37, no. 1, 1968 p 78–97
(JPRS-45080) CFSTI: $3.00

Experimental and theoretical studies of organic semiconducting polymers whose conductivity mode is electronic but not ionic are reviewed. Examined are low molecular weight organic semiconductors; electrical properties of semiconducting organic polymers; and photosemiconducting properties of organic polymers. S.C.W.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-20732# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
PREIGNITION PRODUCTS FROM STORABLE PROPELLANTS AT SIMULATED HIGH-ALTITUDE CONDITIONS

Stanley W. Mayer, David Taylor, and Leroy Schieler Nov. 1967 48 p refs
(Contract F04695-67-C-0158)
(TR-0158(9210-02)-1; SAMSO-TR-68-67; AD-665884)

In view of the destructive ignitions that occur in hypergolic test firings of attitude-control motors under simulated high-altitude conditions, the preignition behavior of MMH, UDMH, A-50, and N2H4 with N2O4 was examined at low pressures and temperatures in the laboratory. Author (TAB)

N68-21267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER CODE FOR CALCULATING TEMPERATURE PROFILES IN A PROPELLANT TANK
Ronald L. Danilowicz Washington Apr. 1968 35 p refs
(NASA-TM-X-1556) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A FORTRAN IV computer code for determining temperature histories in a propellant tank due to wall and internal heating was written. The analysis, on which the code is based, is presented. The assumptions and approximations made are also discussed. Also included are instructions for use of the code, a sample problem, a flow chart and a complete listing of the code. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-20595# Naval Air Propulsion Test Center, Trenton, N. J. Aeronautical Turbine Dept.
A STUDY OF THE EFFECTS OF AN ORIFICE INLET ON THE PERFORMANCE OF A STRAIGHT CYLINDRICAL DIFFUSER
Robert E. Anderson and Philip A. Graham Dec. 1967 20 p refs
(NAPTC-ATD-143; AD-665676)

A series of model tests were run using a variety of circular orifices on the inlet of a straight pipe diffuser installed behind a convergent nozzle. Measurements of static pressure were taken in a sealed plenum surrounding the nozzle exit and diffuser inlet. For the ranges of system and nozzle pressure ratios tested, significant increases in altitude observed in the plenum were obtained using the orifice inlets. The tests show promise for extending the altitude capability of a jet engine test cell. Author (TAB)

N68-21076*# Martin Co., Denver, Colo.
STERILIZABLE LIQUID PROPULSION SYSTEM Quarterly Progress Report, 1 Apr.–30 Jun. 1967
H. F. Brady and J. Keough Jul. 1967 36 p Prepared for JPL *Its* Issue 3
(Contracts NAS7-100; JPL-951709)
(NASA-CR-94041; MCR-67-15; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Exposure of an assembled and fueled bipropellant liquid propulsion system to ethylene oxide (ETO) and heat sterilization environments is being investigated. Normal steel welding practices that permit oxide formation or seam welding of faying surfaces that may form oxides in hidden cavities were not acceptable for sterilization in hydrazine-based fuels. Design and component selection for the system is also under study; and a system module has been completed and released for fabrication. Three-fourths of the components were accepted; test fixtures and procedures for baseline testing were completed; and component baseline performance tests were made. Long-term storage tests of the small-scale propellant tanks were begun, and exposure to high temperature propellant was completed and the specimens were placed in room temperature storage. M.W.R.

N68-21097*# Thiokol Chemical Corp., Elkton, Md.
RADIO ASTRONOMY EXPLORER APOGEE KICK MOTOR Final Report, 5 May 1966–31 Mar. 1967
H. G. Jones 26 Feb. 1968 66 p refs
(Contract NAS5-9336)
(NASA-CR-93965; E75-68) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Presented is a history of the design, development, and testing of the apogee kick motor for the Radio Astronomy Explorer spacecraft. Ten motors were manufactured. The test program consisted of four sea-level firings and two simulated altitude firings. The tests established that the motor meets all design requirements and will perform successfully within the specified environment and constraints. K.W.

N68-21233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BOMBARDMENT THRUSTOR INVESTIGATIONS AT THE LEWIS RESEARCH CENTER
Edward A. Richley and William R. Kerslake Washington 1968 19 p refs To be Presented at 4th Joint Propulsion Specialists Conf. Sponsored by AIAA, Cleveland, 10–14 Jun. 1968
(NASA-TM-X-52423) CFSTI: HC $3.00/MF $0.65 CSCL 21C

The status of various research programs on mercury electron-bombardment thrusters is reviewed. Future thruster requirements as predicted from mission analysis are briefly discussed to establish the relationship with present programs. Thrusters ranging in size from 5 to 150 cm diameter are described. These thrusters have possible near to far term applications extending from stationkeeping to primary propulsion, respectively. Included is a 5 cm thruster having a power-to-thrust ratio of 220 kW/lb; the 15 cm diameter Sert 2 thruster; and, a 30 cm thruster designed to produce a 1.5 ampere beam at 2,700 sec specific impulse. Research activities on thruster components are reported in the context of the various thruster programs. These include glass-coated, single accelerator grids that have accumulated more than 500 hr operating time; high-current hollow cathodes of 10 amperes emission; and a minimum-B discharge chamber. Author

N68-21618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIAGRAM FOR OPTIMUM DESIGN OF A SYSTEM OF SHOCKS IN AXIALLY SYMMETRICAL SUPERSONIC DIFFUSERS WITH EXTERNAL COMPRESSION [DIAGRAMMA DLYA OPTIMAL'NOGO PROYEKTIROVANIYA SISTEMY SKAUKOV V OSESIMMETRIUNYKH SVERKHZUUKOVYKH DIFFUZORAKH S VNESHNIM SZHATIYEM]
A. P. Pudoveyev 18 Jul. 1967 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii (USSR), no. 2, 1966 p 151–153
(FTD-HT-23-682-67; AD-666078)

The article proposes a diagram for designing axisymmetrical multi-shock diffusers which considerably decrease the pressure losses during the stagnation of supersonic air flows. Such a diagram can be used for selecting the optimum geometry of the inner body of a diffuser and for determining the flow parameters. The diagram was constructed for a system consisting of a number of oblique shocks followed by a normal shock. The diagram gives the m number behind a shock and the angles of the shock front and the flow deflection as a function of the m number in front of the shock. Thus, by decreasing after each shock the number of remaining oblique shocks, the overall flow parameters and the geometry of the inner body of a diffuser can be determined. Author (TAB)

N68-21667# Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).
REPORT ON PROCEEDINGS OF THE WGLR COMMITEES FOR AERODYNAMICS AND AIR BREATHING ENGINES, HELD ON JULY 19, 1966 IN KOELN [BERICHT UEBER DIE GEMEINSAME SITZUNG DER WGLR-FACHAUSSCHUESSE FUER AERODYNAMIK UND FUER LUFTANSAUGENDE TRIEBWERKE AM 19 JULI 1966 IN KOELN]
Aug. 1967 104 p refs In GERMAN; ENGLISH summary Conf. held in Koeln (West Germany), 19 Jul. 1966
(DLR-Mitt.-67-23) CFSTI: HC $3.00/MF $0.65

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N68-21668# Technische Hochschule Aachen (West Germany).
AERODYNAMICS OF ENGINE INSTALLATION: INTRODUCTION AND GENERAL REVIEW [AERODYNAMIK DER TRIEBWERKSINSTALLATION EINFUERHRUNG UND UEBERBLICK]
A. Naumann *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. of the WGLR Comm. for Aerodyn. and Air Breathing Engines, Held on Jul. 19, 1966 in Koeln Aug. 1967 p 11–27 (See N68-21667 11-28)

This critical review concerns several papers previously presented at a conference. Discussed are the state of the art as well as theories and experiments on flow conditions, boundary layer interactions, air compression, resistance reduction, and temperature effects on engine intake systems in the high subsonic, transonic, supersonic, and hypersonic range. Supersonic combustion, injection problems, and aerodynamic integration of body, wing, and engine configurations are briefly treated. Most of the subjects are discussed from the designer's point of view. Transl. by K.W.

N68-21669# Entwicklungsring Sud, Munich (West Germany).
ENGINE INSTALLATION FOR TRANSONIC AND SUPERSONIC RANGES [TRIEBWERKSINSTALLATIONEN IM TRANSSCHALL- UND UEBERSHALLBEREICH]
F. Aulehla and H. Langfelder *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. of the WGLR Comm. for Aerodyn. and Air Breathing Engines, Held on Jul. 19, 1966 in Koeln Aug. 1967 p 28–50 (See N68-21667 11-28)

Three separate subjects are treated in this paper. The purpose of the first article is to stimulate interest in combined air-breathing propulsion systems. Past flight experiences with the Griffon delta wing aircraft with a combination of turbofan/ramjet engines are discussed and related to more recent applications of similar propulsion systems. The second article describes two methods for in-flight measurement of net thrust of supersonic aircraft engines. The two methods are the gas generator method and the rake method. The final article is a study of low-drag installation of twin propulsion nozzles in the rear of the fuselage for transonic and supersonic flight. Wind tunnel model experiments and results are briefly discussed. Transl. by K.W.

N68-21670# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
ENGINE INTAKES [TRIEBWERKSEINLAEUFE]
W. Trommsdorf *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. on the WGLR Comm. for Aerodyn. and Air Breathing Engines, Held on Jul. 19, 1966 in Koeln Aug. 1967 p 51–82 (See N68-21667 11-28)

Articles are presented which deal with the following: (1) design considerations for boundary layer control, tail exhaust configurations, inlet flow, jet thrust, and drag effects on the flight characteristics of transonic/supersonic fighter aircraft; (2) a model study for determining the optimum size and geometry of splitter plates for twin inlets at Mach 2.5 and very high Reynolds numbers; and (3) additive drag on subsonic and supersonic inlet cowls and its effects on the performance of supersonic transports, V/STOL transports, and low-altitude attack aircraft. Transl. by K.W.

N68-21671# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
AERODYNAMICS OF VERTICAL TAKE-OFF ENGINES [AERODYNAMIK DER SENKRECHTSTART-ANTRIEBE]
J. Barche *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Proc. of the WGLR Comm. for Aerodyn. and Air Breathing Engines, Held on Jul. 19, 1966 in Koeln Aug. 1967 p 83–104 refs (See N68-21667 11-28)

Theoretical and experimental studies are reviewed of VTOL and V/STOL engine jet flow effects and inlet flow, including interference effects, lift, and fan-in-wing characteristics. A technique for wind tunnel model simulation of jet V/STOL engines is briefly discussed. Included in the review are also X-14A flight tests of a jet VTOL engine and design considerations for the integration of lift-fan V/STOL propulsion systems and airframes. Transl. by K.W.

N68-21679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILIZING EFFECTS OF SEVERAL INJECTOR FACE BAFFLE CONFIGURATIONS ON SCREECH IN A 20,000 POUND-THRUST HYDROGEN–OXYGEN ROCKET
Ned P. Hannum, Harry E. Bloomer, and Ralph R. Goelz Washington Apr. 1968 41 p refs
(NASA-TN-D-4515) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Experimental tests were conducted to assess the worth of injector face baffles as screech suppression devices. Seventeen injector face baffle configurations were evaluated with 94 hot firings. The number of injector face baffle compartments was varied from 3 to 100 with lengths from 1/2 to 2 inches (1.3 to 5.1 cm). Stability data were obtained at a chamber pressure of 300 pounds per square inch absolute and over a range of oxidant-fuel ratios of from 4 to 6. Hydrogen injection temperature was used to rate the stability of the various baffles. The baffle with the lowest self-triggering temperature was considered to be the most stable. The results indicate that injector face baffles 2 inches long produced acoustic stability to the minimum hydrogen injection temperature limit of the test facility with maximum compartment dimensions as large as 9.1 inches. Acoustic stability down to a hydrogen injection temperature of 55°R (31°K) could also be achieved with injector face baffles 1 inch in length when the maximum compartment dimension was less than 4 inches (10.2 cm). One of the configurations was, however, only marginally stable at the reduced temperature. Author

N68-21684* Bell Aerosystems Co., Buffalo, N. Y.
FLUORINE HYDROGEN THRUST CHAMBER HEAT TRANSFER INVESTIGATION Final Status Report
Jan. 1968 44 p refs
(Contract NAS5-3646)
(NASA-CR-94138; Rept.-8354-937001) CSCL 21H

Summary information is presented on the injector fabrication and test, and the thrust chamber design, fabrication, and tests performed in connection with the thrust chamber heat transfer effort. The design, analysis, and procurement of coolant tubes are

discussed, and measurement data are included on the nozzle heat flux distribution in conjunction with the injector development tests. Detailed design drawings are included. M.G.J.

N68-21735*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SLUSH HYDROGEN FLUID CHARACTERIZATION AND INSTRUMENTATION ANALYSIS
D. E. Daney, P. R. Ludtke, C. F. Sindt, and D. B. Chelton 29 Dec. 1967 52 p refs
(NASA Order R-06-006-046)
(NASA-CR-94132; NBS-9701) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The pumping characteristics of slush hydrogen were investigated with a Saturn S-IV B liquid hydrogen chilldown pump. Pump performance and cavitation for slush and liquid hydrogen are the same when the difference in fluid density is considered. No pump wear or damage can be attributed to slush. A nuclear radiation attenuation densitometer was installed on the 450-liter generator. The precision of the densitometer is comparable to the accuracy of the liquid and slush density determination methods. Flow data were taken in the flow loop for triple-point liquid and slush hydrogen. The data were compared to the pressure drop prediction of simple slurry models. The pressure drop of freshly prepared slush is less than that of triple-point liquid at velocities above 12 feet per second. Slush was transferred through several typical cryogenic globe valves and bayonet fittings to evaluate suspected problem areas. Thermally induced pressure oscillations occurred where clearances were excessive. A new apparatus was constructed to perform slush hydrogen particle studies in more detail. Author

N68-21740*# TRW, Inc., Cleveland, Ohio.
DESIGN, TEST, AND EVALUATION OF A HYBRID NOZZLE
Edgar G. Parks, Jr. [1967] 150 p refs
(Contract NAS1-6555)
(NASA-CR-66566; ER-6843-12) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Following material selection by reactivity and thermal shock tests, nozzle throats of Carb-I-Tex 700, TaC, and TaC-graphite composites were subjected to comparative motor tests under conditions of 7500°F combustion temperature and chamber pressures up to 275 psia, using a Flox/Lithium based propellant combination. Tests indicate Carb-I-Tex 700 can be successfully applied as nozzle throat material up to a chamber pressure of 210 psia for firing durations of greater than 62 sec. with only heat sink cooling. Thermal shock sensitivity of TaC and TaC composites was found to be related to the concentration of Fe and O_2 as contaminants. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-21159# Universidade Mackenzie, Sao Paulo (Brazil).
RESEARCH WORKS RELATED TO SOLAR RADIO EMISSION AND V.L.F. PROPAGATION IN THE LOWER IONOSPHERE Annual Report, Jan. 1967–Jan. 1968
Pierre Kaufmann Jan. 1968 30 p refs
(Contracts DAHC19-68-G-0012; DAHC19-68-G-0013; Grants DA-ARO(D)-49-092-65-G76; DA-ARO(D)-49-092-65-G77)
(GRAM-27; AR-5; AD-665509)

The report consists of the following abstracts: (1) Some Results Obtained with VLF Atmospheric Measurements at Sao Paulo, Brazil, (2) VLF Propagation Across the Geomagnetic Anomaly during SIDs, (3) Characteristics of VLF Tracking Stations for Ionospheric Researches, (4) Note on the Establishment of Solar Activity Indices through Measurements at 300 MHz, (5) Experimental Results from Measurements Performed during the 12 November 1966 Total Solar Eclipse with a 4.28 cm Radio Polarimeter, (6) A Note about Partial Solar Eclipse Observed at 100 cm Wavelength on 12 November 1966, (7) The Effect of a Total Solar Eclipse on Long Path VLF Transmission, (8) The Apparent Sky Temperatures and Tropospheric Absorption on Solar Radiation at 7 GHz, (9) Some Characteristics of a S-Component of Solar Radiation Identified on November 1966 Eclipse at 4.28 cm Wavelength, (10) Solar Physics at Mackenzie University, Sao Paulo, Brazil. Author (TAB)

N68-21177# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
THE VAN ALLEN RADIATION BELTS [LES CEINTURES DE RADIATIONS DE VAN ALLEN]
Philippe Touzain Dec. 1967 39 p refs In FRENCH
(CEA-Bib-103)

The Van Allen radiation belts are studied with a bibliography of results published before May 1967. The trapped particles motion in the magnetosphere, their origins and their disappearances, the position in space of electron and proton zones, and finally, the 1962 nuclear explosions and South-Atlantic anomaly influence, are successively examined. Author (NSA)

N68-21190*# Volt Technical Corp., Washington, D. C.
REQUIREMENT OF NEUTRAL HYDROGEN PERIOD IN THE EVOLUTION OF THE UNIVERSE [NEOBKHODIMOST' PERIODA NEYTRAL'NOGO VODORODA V EVOLYUTSII VSELENNOY]
R. A. Syunyayev 16 Apr. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (USSR), v. 179, no. 1, 1968 p 45–47
(Contract NAS5-12487)
(NASA-CR-94046; ST-CLG-IGA-10703) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The hot model Universe is considered, discussing successively the energy losses by the hot plasma, radioemission in the galactic medium, determining z_{max}, examining the heating of gas and the background of the radiowave band. It is shown that hydrogen is neutral for $z<1300$ but >300, and that the formation of various objects took place for $z<300$. Author

N68-21341*# Adelaide Univ. (Australia). Dept. of Physics.
ON THE RELATIONSHIP BETWEEN RECENT MEASUREMENTS OF COSMIC RAY ELECTRONS, NON-THERMAL RADIO EMISSION FROM THE GALAXY AND THE SOLAR MODULATION OF COSMIC RAYS
W. R. Webber (Minn. Univ., Minneapolis) Jan. 1968 79 p refs
(Contract NsG-281-62)
(NASA-CR-94108) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Utilizing recent measurements of the cosmic ray electron spectrum at the earth and the effects of solar modulation on this spectrum we have determined possible limits on the local interstellar electron spectrum. Synchrotron emission from these interstellar electrons is then compared with the local (disk) volume emissivity of non-thermal radio emission as deduced from a study of radio intensity profiles along the galactic equator. The detailed spectrum and magnitude of radio emissivity can be reproduced from the electron spectrum only for very stringent conditions on the magnitude of the local interstellar magnetic field, and the amount of solar modulation of cosmic rays. If the local interstellar electron spectrum which best reproduces the spectrum of local radio emissivity is compared with the electrons expected as secondaries from cosmic ray collisions in the galaxy, it is found that most electrons $\lesssim 300$ MeV may originate via the secondary mechanism. Author

N68-21534*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTENSITY AND TIME VARIATION OF PRIMARY COSMIC RAY ELECTRONS
G. M. Simnett Mar. 1968 37 p refs
(NASA-TM-X-63162; X-611-68-108) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The primary cosmic ray electron differential energy spectrum between 30 MeV and 1500 MeV has been measured with a system composed of a Cerenkov telescope and a lead-scintillator sandwich detector. Results are presented from a balloon flight made at Kiruna, Northern Sweden, in 1967, and these are compared with measurements made in 1965 with a similar detector. The results are well represented by a power law spectrum between 150 MeV and 800 MeV. There is evidence for a rigidity independent (solar) modulation of the electron flux below 600 MeV, which is the highest energy where the results are comparable. The lower limit to the modulation is 20%. There is no evidence for a diurnal variation in the electron intensity. The results of other comparable balloon borne electron experiments are discussed. Author

N68-21731*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALCULATIONS OF NON-DIFFUSE INFRARED RADIATION FROM THE LUNAR SURFACE INCIDENT ONTO A UNIT ELEMENT ABOVE THE SURFACE
James K. Harrison Washington Apr. 1968 38 p refs
(NASA-TM-X-1567) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This report presents the results of calculations of the thermal radiation from the lunar surface incident onto a flat surface of unit area located a small distance above the moon. The orientation and height of the flat surface vary. The thermal radiation from the moon's surface is assumed to be non-diffuse. The calculations show that the thermal energy flux incident onto the flat surface can differ significantly for a lunar surface that emits radiation in a non-diffuse manner when compared to a lunar surface that emits in a diffuse manner. Author

N68-21751# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
BOUNDARY OF ENERGETIC ELECTRONS DURING THE JANUARY 13–14, 1967 MAGNETIC STORM
George A. Paulikas, J. Bernard Blake, Stanley C. Freden, and Sam S. Imamoto Jan. 1968 26 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-20)-5; SAMSO-TR-68-56; AD-665422)

Measurements of energetic electron fluxes were made aboard the synchronous satellite ATS-1 (1966-110A) during the magnetic storm of January 13-14, 1967. Between 0007 and about 0105 UT (approximately 1400-1500 local time) on January 14, the electron fluxes dropped to background levels in a manner which when associated with the onboard magnetometer data suggests that the boundary of the magnetosphere was compressed to less than 6.6 Re on the day side of the magnetosphere. Author (TAB)

N68-21755*# Aeronautical Research Associates of Princeton, Inc., N. J.
STUDY OF COSMIC RAYS IN THE SOLAR ENVIRONMENT Final Technical Report
Oct. 1967 10 p refs
(Contract NAS5-9394)
(NASA-CR-94129) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The major objective of the research is to establish the correct equations that govern the behavior of cosmic rays (both of solar and of galactic nature) in the presence of the solar environment plasma. The ultimate aim is that of constructing the transfer function that relates the local cosmic beam with that in the interstellar space. At every stage in the inference, close comparison is to be made between the theoretical deductions and the observations available. Suggestions concerning pertinent observations are made wherever possible. Papers prepared during the year towards this objective are summarized. A major outcome is an estimate of the interstellar spectrum of cosmic rays and of the X-radiation expected from HI clouds as a consequence of the energy transferred to them by the cosmic rays. Author

N68-21771# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SOME ADDITIONAL ASPECTS OF THE UNEQUAL ACTIVITY OF THE NORTHERN AND SOUTHERN SOLAR HEMISPHERES: MICROWAVE RADIO BURSTS AND SWFS
Gladys A. Harvey and Barbara Bell 1968 15 p refs *Its* Contrib. to Astrophys., v. 10, no. 4
GPO: HC $0.20; CFSTI: MF $0.65

The relative activity of the Northern and Southern Hemispheres in the production of solar and solar-linked terrestrial events is investigated for the period July 1957 through December 1960, with particular attention to shortwave fadeouts (SWFs) and to microwave radio bursts, including those observed at 2800 MHz at Ottawa. The magnitude of the microwave bursts is investigated, by hemisphere, in relation to three terrestrial effects: polar-cap-absorption (PCA) events, geomagnetic storms, and SWFs. As with solar flares, geomagnetic storms, and PCA events, the percentage of microwave bursts associated with the Northern Solar Hemisphere increases with increasing importance of the event, to around 90% for bursts of integrated intensity $\geq 10^5$, great magnetic storms, and PCA events with absorption ≥ 10 db. This substantially exceeds the percentage of all sunspot groups (2692–59% N) and of the largest spot groups with mean area ≥ 1000 millionths of the solar disk (40–68% N). In unexpected contrast, a relatively low percentage of major (3,3+) SWFs are found to come from the Northern Solar Hemisphere (59%N). The hemispheric distribution of the greatest bursts appears to account for that of the PCA sources, but not for that of the sources of great storms or of major SWFs. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-20765# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
MARCH 1966 OBSERVATIONS OF THE GALACTIC SPUR IN THE 20 TO 40 MHZ RANGE
Donald A. Guidice Oct. 1967 54 p refs *Its* Environ. Res. Papers, No. 274
(AFCRL-67-0546; AD-665885)

In March 1966 observations were made at the Arecibo Ionospheric Observatory to map the region of the Galactic Spur (North Polar Spur) in the 20-40 MHz range. Simultaneous observations were made at 38.75, 33.45, 26.70, and 22.30 MHz using a log-periodic feed, a four-way power divider, and individual null-balancing radiometers. Antenna half-power beamwidths were roughly 2.0 degrees at 38.75 and 3.3 degrees at 22.30 MHz. The observations were confined to the 2300-0500 local time period to minimize ionospheric effects. The area observed was between 12h and 16h right ascension, +32 degrees and +2 degrees declination. Results are given in the report. TAB

N68-20966# Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.
ON THE POSSIBILITY OF DETERMINING THE ABSOLUTE ELEVATIONS OF THE POINTS OF LUNAR SURFACE FROM

THE OBSERVATIONS OF THE EARTH [VOZMOZHNOSTI OPREDELENIYA ABSOLYUTNYKH VYSOT TOCHEK LUNNOY POVERKHNOSTI IZ NABLYUDENIY S ZEMLI]
A. A. Gurshteyn Dec. 1967 8 p ref Transl. into ENGLISH from Astron. Zh. (USSR), v. 44, no. 3, 1967 p 672–674
(ACIC-TC-1318; AD-664847) CFSTI: HC $3.00/MF $0.65

Orthographic projection of elevation points of the lunar surface from observations on earth is obtained by reducing the rectangular coordinates of lunar surface points through corrections for the final distance to the eye's point and for the differential refraction and errors of the astrograph's field. Formulas for introducing the above indicated corrections of the orthographic projection are presented. G.G.

N68-20969*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 6 MISSION REPORT. PART 2: SCIENCE RESULTS
10 Jan. 1968 201 p refs
(Contract NAS7-100)
(NASA-CR-93909; JPL-TR-32-1262) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Scientific data derived from the Surveyor VI mission, and results of data analyses are reported. Analyses in the following areas are reported: television observations; lunar surface mechanical properties; lunar surface temperatures and thermal characteristics; astronomy; chemical analyses of the moon at Surveyor VI landing site; electromagnetic properties (magnet test); theory and processes relating to the lunar maria from the Surveyor experiments; and selenographic location of Surveyor VI. S.C.W.

N68-20972*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDY OF LUNAR EARTHSHINE BY PHOTOELECTRIC PHOTOMETRY Final Report, 1 Nov. 1965–30 Sep. 1967
Fred A. Franklin and L. A. Maestre Feb. 1968 19 p refs
(Grant NGR-09-015-025)
(NASA-CR-93974) CFSTI: HC $3.00/MF $0.65 CSCL 03A

A study designed to (1) provide accurate photoelectric photometry of the earthlit portion of the moon, primarily to establish an albedo for the earth; and (2) to investigate the various instrumental and observational constraints that such a type of measurement imposes. Emphasized is the feasibility of using small, semiportable instruments at a number of field stations to monitor via earthshine measurements possible changes in the earth's albedo. The design, construction, and operation of a 5-inch field instrument is reported, and photometric results obtained using the proposed instrument are assessed. It was concluded that: (1) the 5-inch instrument can give individual measures of the earthshine to an accuracy of 0.2 mag, and thus provides an average value of the earth's brightness, but not of fluctuations about the mean; (2) the 5-inch instrument could be improved for performance superior to that investigated by a smaller diaphragm, changing its diameter to 2 to 3 arc/min, and better guiding and setting arrangements; (3) for projects specifically designed to look for changes in the earth's reflectivity, an instrument substantially larger than a 5-inch instrument would be more feasible; and (4) a compromise is very likely possible wherein an instrument as small as a 5-inch is used at phase angles <45°, thus providing a series of measurements during those four to five days of the lunar cycle when the earthshine is brightest. S.C.W.

N68-20991* National Aeronautics and Space Administration, Washington, D. C.
JOURNEY OF THE MOON
[1967] 12 p
(NASA Facts-NF-40/11-67) GPO: $0.30 CSCL 22A

A pictorial presentation depicts the 15 general procedures from launch to recovery that are involved in manned Apollo mission. After 2-1/2 minutes the first stage drops away; and the second stage, which burns 6-1/2 minutes, ignites. The third stage achieves earth orbit and, after checkout, fires again on a lunar trajectory. Adapter panels open and the command/service module turns in space and docks with the lunar module. After docking, the spacecraft separates from the Saturn V third stage. The service module rocket engine fires to slow the spacecraft into lunar orbit. One astronaut remains in this lunar orbit, while the other two land on the moon in the lunar module to explore, obtain samples, and place instruments. With descent stage as a launch pad, the ascent stage fires for liftoff; and the astronauts in the lunar module then rendezvous and dock with the command module. The lunar module is abandoned in orbit and the service module is jettisoned so that the command module can parachute to earth. M.W.R.

N68-21077*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 10: DYNAMIC PROGRAMMING
A. S. Abbott and J. E. Mc Intyre Washington NASA Apr. 1968 155 p refs
(Contract NAS8-11495)
(NASA-CR-1009; SID-66-1678-2, V. 10) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Basic concepts of dynamic programming are presented along with their applications to simple multistage decision processes related to guidance, flight mechanics, and trajectory optimization. The principle of optimality and optimal value functions are discussed, as are the optimization of stochastic systems and the treatment of terminal constraints. Details are included for the limiting process in dynamic programming; with attention to the recursive and Bellman equations, Lagrange and Bolza problems, linear problem with quadratic cost, and the Pontryagin maximum principle. M.W.R.

N68-21079*# Northrop Corp., Huntsville, Ala.
LUNAR DUST DEGRADATION EFFECTS AND REMOVAL/PREVENTION CONCEPTS. VOLUME 2: DETAILED RESULTS Final Report
F. B. Tatom, Vanja Srepel, R. D. Johnson, N. A. Contaxes, J. G. Adams et al 7 Jun. 1967 206 p refs
(Contract NAS8-20116)
(NASA-CR-94044; TR-792-7-207B; TR-323) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Dust degradation of surfaces and a dust removal/prevention concept are discussed in relation to lunar explorations. Selection of dusts and surface coating, the dusting process, and measurement of absorptance and emittance are considered; and experimental data associated with the measurement of surface spectral absorptance of dust-contaminated thermal control coatings are included. Model test materials, working model design, and performance testing data are described for the dust removal/prevention concept; and a list of 169 references is appended. M.W.R.

N68-21128*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
UPPER ATMOSPHERE INTERACTIONS WITH SPACECRAFT
K. M. Foreman and R. A. Oman Mar. 1968 13 p refs Presented at the 3d Natl. Conf. on Aerospace Meteorol., New Orleans, 6–9 May 1968
(Contract NAS8-21090)
(NASA-CR-94079; RE-325J) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Current predictive capability for satellite orbital position, attitude, and lifetime between 150 and 350 km has an estimated uncertainty on the order of 20 percent. This is because of appreciable gaps in our knowledge of the aerodynamic forces and torques and upper atmospheric structure that affect orbiting satellites in these free molecular flow regime conditions. For mission planning and analysis and for satellite system design optimization

of future generations of larger, more complex, and expensive earth satellite configurations, this lack of predictive precision is a serious and intolerable compromise in the required technology. The situation is not likely to improve without independent, realistic (i.e., *in situ*), and accurate determinations of the rarefied gasdynamic and atmospheric factors influencing low orbit satellite behavior. This report discusses the basic issues of rarefied gas-surface interactions (GSI) relevant to this problem and describes the basis for selecting GSI experiments for a research satellite, considering the mission plan and upper atmospheric properties profile. These considerations lead to a conceptual satellite-borne GSI experiment package for deployment in a low eccentricity earth orbit. Author

N68-21182*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DETERMINING THE SPIN AXIS OF A SPINNING SATELLITE
F. O. Vonbun Washington Apr. 1968 11 p refs
(NASA-TN-D-4483) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Spin axis, a unit vector, is determined for a spinning satellite using ground tracking information. Range rate information is found to be adequate for this purpose. The determination of the unit vector is necessary to check onboard sensors once the spacecraft is in orbit. In the case of a slight onboard malfunction, the spin axis could not be determined without this vector. Author

N68-21206# Sandia Corp., Albuquerque, N. Mex.
THEORY OF ASTRONOMICAL SCINTILLATION, PART 2 [ZUR THEORIE DER ASTRONOMISCHEN SZINTILLATION. 2]
H. Elsaesser 12 Jan. 1968 25 p refs Transl. into ENGLISH from Z. Astrophys. (Heidelberg), v. 50, 1960 p 278–295
(SC-T-68-1502) CFSTI: HC $3.00/MF $0.65

Scintillation phenomena are discussed on the basis of a diffraction theory. Starting with a solution of the wave equation by Obuchow, formulae for the rms fluctuation in brightness and direction of visible starlight are derived. Comparison with part 1 shows that geometrical and wave theory give identical results for the changes in direction (seeing). In the case of the brightness scintillation the geometrical approximation is valid for stars near the zenith, whereas diffraction effects cannot be neglected near the horizon. The variation of scintillation with increasing zenith distance can be explained only by the combined effect of turbulent eddies with various sizes. From the measured dependence of the seeing on the zenith distance it follows that the correlation between the fluctuations in the refractive index and the dimensions of the eddies differ from the lower to the upper atmospheric layers. The increase of the brightness scintillation with zenith distance depends strongly upon the telescope's aperture in accordance with the observations. Author (NSA)

N68-21213# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
PERTURBATION OF SATELLITE TRAJECTORIES [DIE STOERUNG von SATELLITENBAHNEN]
J. Tschauner Bundesministerium fuer Wiss. Forsch. Dec. 1967 25 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-37) CFSTI: HC $3.00/MF $0.65

The motion of earth satellites influenced by perturbing accelerations is considered in three differently rotating coordinate systems. The equations of motion derived by introducing a normalization of the coordinates and by using the true anomaly of an unperturbed reference motion as independent variable are highly nonlinear. In the case of small perturbing accelerations one can derive from the linearized equations explicit formulas for computing the first order deviations which are the base of more accurate investigations. Author

N68-21228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW VARIABLE THRUST INTERPLANETARY TRAJECTORY DATA
Edward J. Nime and John S. Mac Kay Washington Apr. 1968 88 p refs
(NASA-TN-D-4431) CFSTI: $3.00 CSCL 22C

The Newton–Raphson algorithm method is used to generate a large number of low-thrust trajectories between Earth and the other planets in the solar system. These paths assume the use of an ideal, variable-thrust rocket that operates at constant jet power. Trajectories include planet flyby, or capture from Earth, and Earth flyby from the other planets. In all cases, the heliocentric travel angle is varied between 30° and 330° for seven different trip times. The data presented include the performance parameter and all the initial values needed to recompute the path. Several terminal conditions, such as velocity components for the flyby cases, are also included. Analytical techniques with numerical examples are presented which consider the application of the data to a variety of manned and unmanned missions and mission profiles. Author

N68-21231*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 15: APPLICATION OF OPTIMIZATION TECHNIQUES
A. S. Abbott and A. L. Blackford Washington NASA Apr. 1968 163 p refs
(Contract NAS8-11495)
(NASA-CR-1014; SID-66-1678-7) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Trajectory and guidance problems encountered in space flight are discussed in the context of three optimization techniques applied to their solution—the Pontryagin maximum principle, the calculus of variations, and dynamic programming. In the problems considered, the formulation is simple enough to allow an analytic solution along with a more general formulation which requires a numerical technique. Although both the calculus of variations and the Pontryagin maximum principle are applied, it is pointed out that the two formulations yield the same results in terms of the equations to be solved and can be considered as different means of looking at one formulation of an optimization technique. While these two techniques lead to a set of first-order ordinary differential equations (for the Mayer-type problem), the application of dynamic programming leads to a set of partial differential equations. It is generally felt that on a theoretical level dynamic programming is not as strong or as applicable as the other two methods. However, the difference in approach could provide a different perspective to the structure of the problem. M.G.J.

N68-21248# Hungarian Academy of Sciences, Budapest.
PHOTOELECTRIC OBSERVATIONS OF VARIABLE STARS
John B. Priser (Lowell Obs.) 1967 43 p refs *Its No.* 61
CFSTI: HC $3.00/MF $0.65

Observations of twenty-eight variable and suspected variable stars, made with the 21-inch reflector and photoelectric equipment of the Solar Variation Program, are tabulated. An attempt was made to choose stars of questionable classification, and to include some semi-regular and irregular variables which had not previously been well observed. The stars were also chosen for their favorable position in the sky for the observing period. The equipment used includes a photometer with a 1P21, standard B and V filters, a GR 1230 DC amplifier, and a recorder. The 1P21 was cooled with dry ice at least two hours prior to the beginning of observations, and dry ice was added each two hours thereafter during the night. Every six or eight weeks the amplifier was calibrated in half and two and a half magnitude steps. The deflections were recorded on a recorder strip-chart potentiometer in the sequence B, sky B, V, sky V, and these were followed by observations of a radioactive

source and the dark current. Many UBV standard stars were observed at various air masses throughout the night in order to determine the extinction and color corrections. E.J.S.

N68-21277# Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 178 17 Apr. 1968 p 1–16 refs (See N68-21276 11-13)

Abstracts, summaries, and occasional full translations from recent Sino-Soviet bloc publications are presented in the field of Astronomy. Specific material covered includes: the first result from the Soviet Union's largest telescope and a review of 50 years of stellar astronomy in the USSR; a review of a theoretical astrophysics textbook; an article on lunar tectonics; a book review on planetary physics; a review article on thermal radio emission from the Milky Way; a review and analysis of data on interstellar hydroxyl; mechanisms of solar flares and energy formation; the relative motion of an artificial satellite to a spheroidal planet; the spectral characteristics of GW Ori and RY Tau stars; the use of Nyquist diagrams in studying collective processes in a system of self gravitating particles; neutrino emission of star energies; reconsideration of relaxation in stellar systems; solar eclipse observations; X-ray emission; heliometric measurements of the equatorial and polar diameters of Jupiter; and magnetic fields in active solar regions. E.J.S.

N68-21342*# Volt Technical Corp., Washington, D. C.
RESULTS OF INVESTIGATION OF MOON'S INTRINSIC RADIATION [REZUL'TATY ISSLEDOVANIYA LUNY PO YEYE SOBSTVENNOMU IZLUCHENIYU]
V. S. Troitskiy 22 Apr. 1968 23 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 10, no. 9, 1968 p 1266–1282
(Contract NAS5-12487)
(NASA-CR-94110; ST-LPS-RAD-10698) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A contemporary model of the structure of the lunar mantle is described which is based on recent investigations of the moon's intrinsic infrared radiation. In reviewing the model, the discussion includes experimental results obtained on lunar radiation, the general principles used in studying the properties of lunar soil in the upper mantle according to its intrinsic radiation, as well as the properties of the upper mantle soil. The general model represents the sum of specific models in which variations of properties in depth, the temperature dependence of these properties, and the effect of surface roughness were considered. The accuracy of the parameter data obtained is characterized by an error of approximately 20 to 25%. The multiplicity of parameters and their mutually compensating effects prevent more accurate results, but the model does correspond to the initial data obtained. R.N.A.

N68-21343*# Volt Technical Corp., Washington, D. C.
MODEL ATMOSPHERE OF PLANET VENUS ACCORDING TO THE RESULTS OF MEASUREMENTS ON THE SOVIET AUTOMATIC INTERPLANETARY STATION VENERA-4
V. S. Avduyevskiy, M. Ya. Marov 19 Apr. 1968 19 p refs Presented at the 2d Conf. on Planetary Atmosphere, Tucson, Ariz., 11–13 Mar. 1968
(Contract NAS5-12487)
(NASA-CR-94109; ST-LPS-PA-10704) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Details are presented of the experiment conducted on Venera-4 as it descended on the surface of Venus by parachute from the altitude of about 28 km. Based mostly on extrapolation, this paper is accompanied by 12 original diagrams. It is probable that some of the conclusions relative to pressure, temperature, and density will be further adjusted. Author

N68-21352# Denver Research Inst., Colo.
NON-THERMAL OPTICAL EFFECTS ON THE MOON
Jane B. Blizard Mar. 1968 157 p refs
(Contract AF 19(628)-4797)
(AFCRL-68-0069; SR-2; AD-666440)

The report investigates quantitatively the following aspects of lunar events: types and energy sources; topographic factors; electrostatic and space charge effects; surface parameters: albedo, polarization, colorimetry, photometric differences, ambient temperatures, isotherms and cooling curves; and, gaseous and mineral luminescence. Author (TAB)

N68-21367# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
ON THE DISTRIBUTION OF LARGE LUNAR CRATERS
Luciano B. Ronca Jan. 1968 41 p refs
(D1-82-0697; AD-666592)

The size distribution and location of all the craters of classes 1, 2, and 3 larger than 25 km in diameter on the front face of the moon were studied. The diameter distribution of the craters follows approximately the distribution that would be expected from meteoritic impact. Lateral variations in cratering over the lunar surface were determined by dividing the lunar disk into 172 equiareal zones, each of approximately 76,900 sq km. The number of craters, their average diameter and the sum of their diameters were measured in each zone. When these parameters are contoured on the lunar surface, they outline not only the maria but also areas on the terrae otherwise indistinguishable. On the terrae the amount of cratering is not random; highly cratered areas occur clustered together with a correlation coefficient of 0.776. Lateral variations in size distribution were studied by dividing the front face of the moon into 9 zones, each of which has at least 60 large craters and follows approximately the physiography. The main variations are due to the maria and terrae distribution; however, differences in the terrae are also indicated. It is concluded that meteoritic impact cannot offer all the answers to the origin of lunar craters. Either the craters are predominantly volcanic, or some endogenic control on the size of an impact crater exists. Author (TAB)

N68-21410# Manchester Univ. (England). Dept. of Astronomy.
RELATIVE HEIGHTS OF PHOTOGRAPHIC FEATURES OF THE MOON Final Scientific Report, 15 Dec. 1964–14 Jun. 1967
Zdenek Kopal 24 Nov. 1967 56 p refs
(Grant AF-EOAR-64-49)
(AFCRL-68-0073; AD-666026)

The present report summarizes the selenodetic work carried out at the University of Manchester on the determination of the shape of the Moon based on the measurement of negatives taken at different lunar librations from the Observatoire du Pic-du-Midi, as well as the positional work on other satellites of the solar system (Jupiter, Saturn) observed photographically at Pic-du-Midi and at the Kottamia Observatory in Egypt. Author (TAB)

N68-21442*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 17: GUIDANCE SYSTEM PERFORMANCE ANALYSIS
D. R. Grier Washington NASA Apr. 1968 221 p refs
(Contract NAS8-11495)
(NASA-CR-1016; SID-66-1678-9) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A study of the methodology of system performance analysis which forms the principles and techniques of direct applicability in assessing guidance system performance and requirements; is reported. Methodology considered is directly applicable to a guidance system which is dependent upon particular mission considerations. Discussed are basic concepts of randomness and probability

among which are considered: (1) Gaussian random variables, the multivariate Gaussian probability density function, and probabilities for Gaussian random vectors; (2) functions of random variables with particular emphasis on transformations of probability density functions and statistical moments of functions of random variables; (3) several particular functions of Gaussian random variables with emphasis upon the probability density functions and statistical moments; (4) several basic probability bounds which can generally be used to bound random variables when only lower order statistical moments are known; (5) several basic limiting theorems which generally concern the limiting behavior of sums of statistically independent random variables; (6) statistical property determinations with particular emphasis on estimating moments and examining the validity of assumptions concerning probability density functions; (7) the particular case of estimating statistical moments for Gaussian random variables; (8) basic methods of correlation and regression analyses; and (9) the use of confidence intervals and the method of hypothesis testing. S.C.W.

N68-21464*# Volt Technical Corp., Washington, D. C.
RESULTS OF OBSERVATIONS OF 560 RADIO SOURCES IN THE FREQUENCY OF 86 MEGAHERTZ [REZUL'TATY NABLYUDENIY 560 RADIOISTOCHNIKOV NA CHASTOTE 86 MGH]
V. S. Aetyukh, V. V. Vitkevich, R. D. Dagkesamanskiy, and V. N. Kozhukhov 20 Apr. 1968 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (USSR), v. 178, no. 6, 1968 p 1271–1272
(Contract NAS5-12487)
(NASA-CR-94112; ST-RA-SA-10705) CFSTI: HC $3.00/MF $0.65 CSCL 03A

This note is an abstract of the results of measurements of flux densities of radio sources from catalogs 3C and 3CR using 560 radio sources in the frequency of 86 mc/s, and carried out from February 1965 to June 1967. Author

N68-21476# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Institut fuer Geophysik und Meteorologie.
THE EXPLORATION OF THE PLANET JUPITER [DIE ERFORSCHUNG DES PLANETEN JUPITER]
F. M. Neubauer Bundesmin. fuer Wiss. Forsch. Dec. 1967 179 p refs In GERMAN; ENGLISH summary Proceedings of Meeting Held at Celle, W. Ger., Apr. 1967
(BMwF-FB-W-67-40) CFSTI: HC $3.00/MF $0.65

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N68-21477# Yale Univ., New Haven, Conn.
[PRINCIPLES OF PLANETARY CONSTITUTION AND ITS APPLICATION TO JOVIAN CHARACTERISTICS]
Rupert Wildt *In* Tech. Hochschule Carolo Wilhelmina the Exploration of the Planet Jupiter Dec. 1967 p 10–86 refs (See N68-21476 11-30)

A review is presented of major observed data, several basic theories, and of attempts to correlate this information. The physical principles concerning planetary structures are analyzed based on the hydrostatic equation and the equation for the temperature gradient. The need for additional experimental data on the equations of state for hydrogen and helium is pointed out in order to improve existing models of the interior of Jovian planets. The current stand of studies of temperature and composition of Jupiter's surface layers is discussed, and the theories for planetary model atmospheres are critically evaluated. Transl. by K.W.

N68-21478# Entwicklungsring Nord, Bremen (West Germany).
TRAJECTORIES AND PROPULSION FOR A JUPITER SPACE FLIGHT [BAHNEN UND ANTRIEBE FUER EINEN FLUG ZUM PLANETEN JUPITER]
H. Tolle and K. Rissmann *In* Tech. Hochschule Carolo Wilhelmina The Exploration of the Planet Jupiter Dec. 1967 p 86–112 refs (See N68-21476 11-30)

A trajectory analysis and propulsive requirements are presented for Jupiter missions with chemical propulsion systems. The individual trajectories were obtained in sections constituting two-body problems. An Atlas Centaur launch vehicle was considered for flyby missions, and a Saturn 5 is proposed as the minimum for relatively low satellite trajectories with a perigee from 10,000 to 30,000 km and an apogee of 200,000 km. Launch vehicles of the Saturn 1B/Centaur type were found to suffice for higher satellite trajectories, such as one of $2.5 \cdot 10^8$ km for example. Transl. by K.W.

N68-21479# Bölkow Entwicklungen K. G., Munich (West Germany).
METEOR AND RADIATION PROTECTION FOR JUPITER PROBES [METEOROIDEN- UND STRAHLUNGSSCHUTZ BEI JUPITERSONDEN]
W. Kokott *In* Tech. Hochschule Carolo Wilhelmina The Exploration of the Planet Jupiter Dec. 1967 p 113–127 refs (See N68-21476 11-30)

Latitudinal, radial, and brightness distributions of asteroids, meteoroids, and micrometeoroids are estimated based on satellite data and model studies. The reliability of extrapolation is considered as a means for establishing distributions and flux densities in the entire solar system and in the asteroid belt. Briefly discussed are shielding requirements, materials, and penetration characteristics for meteoroids and corpuscular radiation. Transl. by K.W.

N68-21480# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROBLEMS OF ENERGY SUPPLY [PROBLEME DER ENERGIEVERSORGUNG]
W. Rasch *In* Tech. Hochschule Carolo Wilhelmina The Exploration of the Planet Jupiter Dec. 1967 p 128–146 ref (See N68-21476 11-30)

The feasibility and the advantages of using solar cells, radioisotope generators, fission electric cells, and thermionic converters as energy sources for Jupiter spacecraft are explored. Launch vehicle payload capacities, weight of the power systems, power densities, and the characteristics of important radioactive isotopes are evaluated. The resulting power efficiencies are applied to derive data transmission capabilities for the spacecraft. Transl. by K.W.

N68-21482# Bölkon Entwicklungen K. G., Munich (West Germany).

PROBLEMS OF STABILITY CONTROL AND THERMAL INTERPRETATION IN RELATION TO THE MISSION PROFILE [PROBLEME DER LAGEREGELUNG UND DER THERMISCHEN AUSLEGUNG IN ABHAENGIGKEIT VON MISSIONSPROFIL]

D. E. Koelle *In* Tech. Hochschule Carolo Wilhelmina The Exploration of the Planet Jupiter Dec. 1967 p 167–181 Supported in part by Bundesmin. fuer Wiss. Forsch. (See N68-21476 11-30)

The advantages and disadvantages of four attitude control concepts are evaluated with a view toward application to Jupiter probes. These concepts are: (1) spin stabilization with the axis vertical to the ecliptic; (2) spin stabilization with the axis to the earth; (3) attitude stabilization with fixed antenna; and (4) attitude stabilization with drag antenna. The application of these concepts to four different planetary probe configurations is discussed. The effects of thermodynamic design considerations of a probe on stability control are briefly covered. Transl. by K.W.

N68-21553*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OBSERVATIONS OF THE MAGNETOSHEATH-SOLAR WIND BOUNDARY

L. F. Burlaga and K. W. Ogilvie Apr. 1968 60 p refs

(NASA-TM-X-63155; X-612-68-3) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Explorer 34 plasma data are presented which provide tests of current theories of the nature of the boundary between the earth's magnetosheath and the interplanetary medium. It is shown that a discontinuous transition between the magnetosheath and the interplanetary medium is seen simultaneously in the proton spectrum, the flow direction, and the magnetic field intensity, during both geomagnetically quiet and disturbed times. Observations of the velocity field in the neighborhood of the outer boundary of the magnetosheath are presented and are compared with results of the fluid theory, which predicts a standing shock. It is shown that, along the boundary on the flank of the magnetosheath, the ratios of the magnetosheath flow speed to the interplanetary flow speed are in close quantitative agreement with a prediction of the fluid theory. This prediction is essentially independent of the Mach number and the adiabatic exponent. A highly directional flow is observed in the region $30^\circ \leq \theta \leq 100^\circ$, where θ is the sun–earth–satellite angle. The direction of this flow is in good agreement with the bow shock theory. Author

N68-21650*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SIMULTANEOUS MEASUREMENTS ON THREE SATELLITES AND THE OBSERVATION OF THE GEOMAGNETIC TAIL AT 1000 R_E

D. H. Fairfield Apr. 1968 29 p refs

(NASA-TM-X-63166; X-612-68-124) CFSTI: HC $3.00/MF $0.65 CSCL 22B

During the last week of September 1966 the heliocentric orbiting spacecraft Pioneer 7 was behind the earth in a position to observe the geomagnetic tail between 900–1050 R_E. At the same time Explorer 28 and Explorer 33 were monitoring the interplanetary medium and the magnetosheath near the earth. Comparison of these simultaneous magnetic field measurements permits the isolation of intervals when Pioneer 7 is observing steady, enhanced-magnitude solar or antisolar directed fields characteristic of the extended geomagnetic tail which are different from the interplanetary fields convecting past the other two spacecraft. The occurrence of approximately 10 intervals of tail observation of duration from a few minutes to several hours is interpreted as a sweeping of the tail across the spacecraft as the tail responds to variations in the direction of plasma flow. Discontinuous features in the interplanetary magnetic field are also found to convect past the three spacecraft with velocities which compare well with interplanetary solar wind velocities measured by the Vela satellites at the same time. Field magnitudes near the tail at 1000 R_E are found to be weaker than the corresponding interplanetary field as is predicted by the magnetogasdynamic theory. Author

N68-21685*# North American Aviation, Inc., Downey, Calif.

GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 5: STATE DETERMINATION AND/OR ESTIMATION

G. E. Townsend, D. R. Grier, R. R. Palmer, R. J. Ruggiero, and A. S. Abbott Washington NASA Apr. 1968 255 p refs

(Contract NAS8-11495)

(NASA-CR-1004; SID-65-1200-5) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Attention is focused on the basic problem of generalizing precise information regarding the trajectory of an observed vehicle and the coefficients of the mathematical model used in the prediction from a set of observations made of the vehicle. The task of generating a reliable first approximation to the true trajectory is discussed, and optimum estimates of the deviation vector are developed. The development of simple measures of the degree of optimality in the estimator, and the generation of the estimation equations and estimation error for these measures are discussed. The classical least squares, weighted least squares, and minimum variance estimators are derived, and consideration is given to modern estimation in a recursive mode. Filter concepts are assessed and tailored to problems where the statistics involved are Gaussian, where the dynamics can be approximated by the linear model, and where the optimum estimator is a linear function of the deviations in the observables. Matrices relating the dynamics at various times relative to the nominal trajectory, and the matrix presenting the error data for the observables are derived. Recommendations for applying these data are made. M.G.J.

N68-21700 Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).

INVESTIGATION OF THREE-DIMENSIONAL TRAJECTORIES OF LIFTING RE-ENTRY VEHICLES

W. Hein, F. Mysliwetz, and F. Oppelt Bundesministerium Fuer Wiss. Forsch. Sep. 1967 31 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.

(BMwF-FB-W-67-28) CFSTI: $3.00

For the second stage of an aero-space transport, re-entry trajectories, and footprints have been determined at various bank angles and lift to drag ratios. The maximum longitudinal range that can be obtained under the assumptions made in this investigation amounts to 3/4 of the earth-equator, whereas a maximum cross range of 60° can be reached. Temperatures on the lower surface of the wing, and at the stagnation point are about 150 to 200°K higher for the banked entry maneuvers than for corresponding plane trajectories. Normal accelerations though higher, remain under 3 g's. Author

N68-21702*# Texas Univ., Austin. Center for Research.

CHARACTERISTICS OF APOLLO-TYPE LUNAR ORBITS

George H. Born (M.S. Thesis, Jan. 1965) 6 Jun. 1968 84 p refs

(Contract NAS9-2619)

(NASA-CR-62058; TCR-7) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A computer routine for numerically integrating Lagrange's planetary equations for lunar satellite orbits was revised to integrate an alternate set of perturbation equations which do not have the small eccentricity restriction of Lagrange's equations. This set of equations was solved numerically for the time variations of the

orbit elements of circular lunar satellite orbits. Consideration was given to orbits with near equatorial inclinations and low altitudes similar to those considered for the Apollo project. The variations with time of the orbit elements for 12 sets of initial conditions were investigated. Data showing the results for both short time (3 revolutions of the satellite) and long time (80 revolutions) are presented in both tabular and graphical form. Author

N68-21710* Hawaii Univ., Honolulu.
ADJUSTMENT OF SATELLITE TRIANGULATIONS
R. A. Hirvonen [1967] 15 p
(Grants NGR-12-001-045; NGR-12-001-036)
(NASA-CR-94140) CFSTI: $3.00 CSCL 22A

First, the elementary problem is discussed: Given the earth fixed space directions from two non-intervisible ground stations A and B to two elevated points 1 and 2, find the direction AB. In the practice, more than two elevated points will be used; therefore, a preliminary adjustment for each side AB is carried out. As the result of this adjustment, two correlated quantities are obtained which can be used, in the main adjustment of a network of several stations, as fictive observations. If there are N stations, the main adjustment contains 3N parameters. Four of these parameters cannot be determined by the triangulation. On the other hand, it hardly is advisable to include in the main adjustment such observations as satellite distances, ground triangulations, levelings, and astronomical coordinates (with gravimetric deflections of vertical). Therefore, it is suggested that four additional conditions are used, in order to keep the gravity center of all stations and the mean scale of the approximate coordinates fixed. In this way, the overall accuracy obtainable by the adjustment of the network can be estimated. Author

N68-21716# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
A GENERAL METHOD OF ORBIT DETERMINATION [LOESUNGSVORSCHLAG ZUM BAHNBESTIMMUNGSPROBLEM]
M. Schneider Bundesministerium fuer Wiss. Forsch. 15 Oct. 1967 23 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-35) CFSTI: HC $3.00/MF $0.65

The problem of orbit determination is considered as a boundary value problem. The equivalent integral equation is solved by Hammerstein's method of an infinite number of variables. The proposed method solves the combined problem of preliminary and definitive orbit determination. Sample results of preliminary orbit determination obtained with this method are given to prove the effectiveness of the method. Author

N68-21727 AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
CLARIFICATION OF THE RELATIONS BETWEEN ORBIT PARAMETERS REFERRING TO SATELLITES, SPACE PROBES AND SPACE TRANSPORTERS AND MEASUREMENTS OBTAINED FROM VARIOUS RADIO-DETERMINATION PROCEDURES. CONSIDERATION OF THE REQUIRED ACCURACY [KLAERUNG DER ZUSAMMENHAENGE ZWISCHEN DEN FUER DIE RAUMFAHRT WICHTIGEN BAHNPARAMETERN VON SATELLITEN, RAUMSONDEN UND RAUMTRANSPORTERN UND DEN DURCH DIE VERSCHIEDENEN FUNKORTUNGSVERFAHREN ERHAELTLICHEN MEBGROEBEN. BETRACHTUNG DER ERFORDERLICHEN GENAUIGKEITEN]
H. Karger, R. Lesiow, H.-J. Roensberg, G. Seiler, and W. Zoberbier Bundesministerium fuer Wiss. Forsch. Sep. 1967 176 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-29) CFSTI: HC $3.00/MF $0.65

The relations between the values measured by position fixing equipment and the parameters required for precise definitions of locis of satellites are described. Incorrect values, deviations and other faults are analysed with reference to these parameters. The paper describes the practical design of position fixing equipment as well as the effect of atmospheric turbulence on the antenna pattern. Finally a review is presented of potential faults occurring in parabolic tracking antennas. Author

N68-21733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A HUMMINGBIRD FOR THE L_2 LUNAR LIBRATION POINT
F. O. Vonbun Washington Apr. 1968 15 p refs
(NASA-TN-D-4468) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This paper concerns a spacecraft not in a circumlunar orbit, but in a quasi-permanent position in the vicinity of the far-side lunar libration point L_2. Such a spacecraft would be a useful communications relay between the back of the moon and the earth. It could be so placed above the libration point as never to be occulted, thus making the communication link a continuous one, independent of time. The spacecraft would be in the lunar gravitational field and thus need permanent thrust to stay in place or to move slowly around a point in space like a hovering hummingbird. This report shows analytically the accelerations in the vicinity of L_2 and the specific impulses needed to keep a spacecraft there economically with a reasonable fuel-to-mass ratio ($m_f/m_o = 0.05$ to 0.15). This dictates the kinds of engines needed for such missions, where constant, small accelerations are needed over the lifetime of a spacecraft (in the order of 1 to 3 years). Author

N68-21753# Air Force Cambridge Research Labs., Bedford, Mass.
AFCRL SPACE SCIENCE RESEARCH DURING 1967 (ANNUAL REPORT TO COSPAR)
A. Mc Intyre, ed. Jan. 1968 53 p refs *Its* Spec. Rept.-70
(AFCRL-68-0011; AD-665853)

A summary of the space science organization and facilities of Air Force Cambridge Research Laboratories (AFCRL); its international activities in space science; rockets, satellites, and balloons launched; results of experiments associated with the moon, planets, micrometeroroids, solar physics, energetic particles and magnetic fields, upper atmosphere physics, meteorology, geodesy, and terrestrial photography; planned research in 1968; and a space science research related bibliography are included. The definition of space science for the purpose of this report is limited to in-situ observations and measurements using the broad definition of space. Author (TAB)

N68-21792*# Texas Univ., Austin. Center for Research.
CHARACTERISTICS OF NEAR-CIRCULAR LUNAR SATELLITE ORBITS
David Hawkins (M.S. Thesis) Aug. 1966 73 p refs
(Contract NAS9-2619)
(NASA-CR-62055; TCR-8) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Near-circular lunar satellite orbits of low inclination, corresponding to the types planned for Apollo missions, are investigated numerically as a four-body problem. A computer program was written to numerically integrate a modified set of perturbation equations which is free of the small eccentricity restriction encountered in the classical Lagrangian set. Machine plots are obtained for the time variation of local maximum and minimum values of the short period oscillations in the orbit elements over a total time span equivalent to one complete circuit of the Moon about the Earth (the anomalistic period). The computer routine receives disturbing body position data from modified JPL ephemeris tapes. The results for eight sets of initial conditions are presented

in tabular and graphical form. It is concluded that all orbit types considered exhibit a high degree of stability for a period of 28 days. Author

N68-21800 Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
INVESTIGATION OF THE POSSIBILITY OF A BALLISTIC FLIGHT TO A REQUIRED ORBIT PLANE [BALLISTISCHER ANFLUG ZUR GEWUENSCHTEN UMLAUFBAHNEBENE]
D. Ortlieb Bundesministerium fuer Wiss. Forsch. Sep. 1967 29 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-27) CFSTI: $3.00

The problem of acquiring equatorial orbits from launching sites of great latitudes by skipping and turning maneuvers in the upper atmosphere is investigated. The equations of motion are simplified so that an analytical treatment becomes possible. Optimum guidance functions for minimum velocity losses are obtained by the classical calculus of variations. Integration of the simplified trajectory equations with conclusion of the optimum guidance functions leads to an analytical relation between the ratio of the exit- to the entry-velocity, the required entry angle, and L/D-ratio for the desired orbital plane changes. In the graphical representation of this relation the limits due to acceleration and other factors are considered. Author

N68-21801# Air Force Cambridge Research Labs., Bedford, Mass.
RADIO ASTRONOMY: A REVISION OF CHAPTER 22, HANDBOOK OF GEOPHYSICS AND SPACE ENVIRONMENTS
D. A. Guidice Nov. 1967 74 p refs *Its* AF Surv. in Geophys., No. 199
(AFCRL-67-0621; AD-663717)

The survey is a summary of available information on radiation environments at radio frequencies (about 10 m to 1 cm wavelength); the Moon, the Planets, and space beyond the solar system are described. The topics presented are refraction and absorption of extraterrestrial radio waves by Earths atmosphere, radio and radar observations of the Moon and Planets, radio emission from the celestial sphere (background radiation), discrete sources of continuum radio emission, and spectral-line radiation from neutral atomic hydrogen and from the hydroxyl radical (OH). Author (TAB)

N68-21802*# National Aeronautics and Space Administration, Washington, D. C.
PHYSICS OF PLANETS
V. I. Moroz Apr. 1968 416 p refs Transl. into English of the publ. "Fizika Planet" Moscow, Nauka Press, 1967
(NASA-TT-F-515) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Planetary physics deals with the physical characteristics of the planets and their satellites: the temperature of the planet surface and atmosphere; the composition, density and vertical structure (i.e., the altitude dependence of temperature, composition and density) of the atmosphere, the nature of the cloud layer, circulation of the atmosphere, the nature of the observable surface features and surface layer, and lastly, the internal structure. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-20831*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 TEMPERATURE CONTROL SUBSYSTEM
D. W. Lewis, D. C. Miller, and L. N. Dumas 15 Sep. 1967 36 p refs
(Contract NAS7-100)
(NASA-CR-93920; JPL-TR-32-957) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The first successful attempt to photograph Mars at close range was made by the Mariner Mars 1964 spacecraft. To meet the requirements for this mission, the temperature of the components had to be controlled within desired limits. This report reviews the design and the techniques used to make this control possible. As a verification of the design, a series of ten tests was conducted using a temperature control model (TCM) of the spacecraft. These tests were followed by testing of more flight-type models: first, a proof-test model which was not flown, and, subsequently, each flight model. This, however, did not completely represent the real spacecraft in the flight environment, because of ground support equipment and cabling attached to the spacecraft. Flight temperatures were observed and found to compare favorably with test results. Discrepancies were also observed and discussions are noted in the report. Author

N68-20872*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR MISSION OPERATIONS SYSTEM. SPACE FLIGHT OPERATIONS MEMORANDUM SURVEYOR 7
R. Callan 1 Mar. 1968 25 p refs
(Contract NAS7-100)
(NASA-CR-93968; JPL-PD-602-74) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Space flight operations for the Surveyor Mission G through its second lunar day are described; and a mission summary gives highlights of the transit phase and both first and second day lunar operations. Transit phase was conducted from January 7, 1968, through touchdown on January 10, when lunar operations commenced. All Surveyor VII first lunar day operations ended on January 26; and second day operations cover the period from February 12 through 21. Mission control is discussed as are analysis and command for the spacecraft performance, flight path, and space science aspects. Attention is given to the television ground handling system, data processing system, space flight operations facility, deep space instrumentation facility, tracking and data system near-earth phase support, and ground communications. M.W.R.

N68-20880*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 TEMPERATURE CONTROL SUBSYSTEM
D. W. Lewis, D. C. Miller, and L. N. Dumas 15 Sep. 1967 35 p refs
(Contract NAS7-100)
(NASA-CR-93915; JPL-TR-32-957) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The first successful attempt to photograph Mars at close range was made by the Mariner Mars 1964 spacecraft. To meet the requirements for this mission, the temperature of the components had to be controlled within desired limits. This report reviews the design and the techniques used to make this control possible. As a verification of the design, a series of ten tests was conducted using a temperature control model (TCM) of the spacecraft. These tests were followed by testing of more flight-type models: first, a proof-test model which was not flown, and, subsequently, each flight model. This, however, did not completely represent the real spacecraft in the flight environment, because of ground support equipment and cabling attached to the spacecraft. Flight temperatures were observed and found to compare favorably with test results. Discrepancies were also observed and discussions are noted in the report. Author

N68-20935# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

ANALYSIS OF AERODYNAMIC DATA OBTAINED DURING ELDO F-5 FLIGHT

W. B. de Wolf 15 Sep. 1967 32 p refs

(NLR-G.62) CFSTI: HC $3.00/MF $0.65

During the ELDO F-5 flight trial a number of pressures have been measured on the nose fairings of the vehicle. This report presents the flight conditions (Mach number, dynamic pressure, angles of incidence, sideslip and total angle of incidence) and pressure distributions on the nose fairings as obtained from these measurements. The flight conditions, thus obtained, are compared with calculations from trajectory, meteorological and vehicle attitude data. Mach number and dynamic pressure, as obtained from both methods, show very good agreement. Pressure distributions are compared with wind tunnel results, showing reasonable agreement. The total angles of incidence obtained from both methods show differences of up 2 degrees or more. Author

N68-20965# National Research Council of Canada, Ottawa (Ontario).

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF BLACK BRANT V AT MACH NUMBER 7 IN HELIUM

J. G. Laberge Dec. 1967 45 p ref

(NRC-10032; LR-491)

Two slightly different configurations of the Black Brant V rocket were tested at Mach number 7 in the NAE helium hypersonic wind tunnel. Static longitudinal characteristics were measured at two Reynolds numbers differing by a factor of 8, over a nominal incidence range of ±5 degrees. The helium results were converted to equivalent air results and compared with those of the NAE 5-foot air wind tunnel, in which the maximum Mach number reached was 4.25. The results from both tunnels were compared with calculated values. Author

N68-20988*# Sperry Rand Corp., St. Paul, Minn.

MARINER VENUS 67 DYNAMIC FLIGHT DATA

D. O. Brand 15 Mar. 1968 75 p refs Prepared for JPL

(Contract NAS7-100)

(NASA-CR-93911; JPL-TR-32-1185) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The dynamic flight environment of the Mariner V (Venus 1967) spacecraft is analyzed. Six environmental measurements were taken; data were obtained from two microphones attached to the launch complex umbilical tower, two microphones attached to the umbilical boom, and two accelerometers, one mounted on the spacecraft itself and one on the adapter ring. Recorded data from those transducers have been analyzed and are presented as oscillograms, power spectra, and shock spectra. The recorded data were of usable quality; however, recommendations are made to improve the signal-to-noise ratio and to provide more measurement locations on future spacecraft. The reduced data are compared with data obtained from Mariners III and IV and with ground test data. Results indicated that the Mariner V flight environment was comparable to those of previous Mariners and that the ground random vibration test levels were adequate. The ground pyrotechnic test appeared adequate; however, a less rigid spacecraft support is recommended during future pyrotechnic tests. Author

N68-20989*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DESIGN, TEST, AND PERFORMANCE OF THE MARINER 5 TEMPERATURE CONTROL REFERENCE

W. F. Carroll 1 Apr. 1968 31 p refs

(Contract NAS7-100)

(NASA-CR-93921; JPL-TR-32-1250) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Mariner V Temperature Control Reference (TCR) was designed to measure, in space, the net solar thermal energy absorbed by typical spacecraft temperature control surfaces for correlation with laboratory measurements, solar simulation, and materials environmental testing. Valuable information was obtained during the Mariner V mission to Venus in 1967. The white surfaces, S-13 and S-13M, degraded more rapidly than had been predicted from laboratory testing. The black, which was intended to provide a reference to solar simulator intensity, demonstrated an unexpected decrease in the product $S\alpha_s/\epsilon$ of the order of 4%. The design, testing, and performance of the equipment and the indicated data on the coatings are discussed in detail. Author

N68-20997# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

SIMULATION OF THE ATTITUDE STABILIZATION OF THE DODGE SPACECRAFT WITH TIME-LAG MAGNETIC DAMPING

V. L. Pisacane, P. P. Pardoe, and J. M. Whisnant Oct. 1967 60 p refs

(Contract NOw-62-0604-c)

(APL-TG-949; AD-665686)

The DODGE experiment has two objectives, first to achieve gravity-gradient stabilization at near synchronous altitudes and second to determine the adequacy of theoretical analyses by correlation between simulation results and experimental data. This paper presents, by means of a digital simulation, the expected performance of the spacecraft with the time-lag magnetic damper. This satellite will be the first to use this gravity-gradient stabilization system which, because of its inherent simplicity and absence of moving parts, is particularly applicable to long life satellites. TAB

N68-21280*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FEASIBILITY STUDY OF OPTIMUM ON–OFF ATTITUDE CONTROL SYSTEM FOR SPACECRAFT

John D. Regetz, Jr. and Thomas M. Nelson Washington Apr. 1968 24 p

(NASA-TN-D-4519) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Attitude control of orbiting spacecraft is generally performed in an on–off mode; no corrective thrust is provided until a preset angular error is obtained. For a given disturbance torque, the phase-plane trajectory then depends on the size of the angular impulse imparted during thrusting. For comparatively large angular impulses, the trajectory contacts both deadband limits alternately; for small impulses, the disturbance reverses the spacecraft angular rate before it can contact one side of the deadband. If the thrustor firing time is controlled, a limit cycle can be obtained in which the maximum angular excursion within the deadband is such that the spacecraft just misses contacting the opposite deadband limit. The fuel consumption is then minimum because a single-sided trajectory is maintained, and the number of thrust pulses during a given control period is minimized because the time between firings is a maximum. A single-axis control system that provides this optimum trajectory was functionally designed and investigated by simulation on an analog computer. The system calculates spacecraft angular velocity and acceleration of the deadband limit, and determines the thrustor "on" time which produces the optimum trajectory. Author

N68-21288*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

ATLAS/AGENA-24. LUNAR ORBITER-5. FLASH FLIGHT REPORT

4 Aug. 1967 25 p

(NASA-TM-X-60888; TR-562) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Summary data are presented on the prelaunch and launch operations, and the flight performance of the Atlas/Agena-24 launch vehicle for the Lunar Orbiter 5 spacecraft. The launch vehicle configuration is briefly discussed and its flight performance through spacecraft separation and the Agena retromaneuver are described with respect to the subsystems involved. Various test and propulsion data are tabulated as is the sequence of flight events. The range telemetry, radar, and optical data acquisition systems used are briefly discussed. E.J.S.

N68-21297*# Volt Technical Corp., Washington, D. C.
A NEW ARTIFICIAL SATELLITE OF THE MOON
22 Apr. 1968 3 p Transl. into ENGLISH from Russian
(Contract NAS5-12487)
(NASA-CR-94111; ST-PR-LPS-10706) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A Tass press report is presented on the Luna-14 mission. Some of the measurements and observations made by the Luna-14 are listed. B.S.D.

N68-21298*# North American Rockwell Corp., Downey, Calif. Space Div.
WIND FIELD ANALYSIS FOR CANTILEVER LOADS
B. H. Ujihara Huntsville, Ala. NASA Marshall Space Flight Center Feb. 1968 163 p refs
(Contract NAS8-21138)
(NASA-CR-61198; SD68-16) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Test data consisting of anemometer strip chart recordings taken during the 1966 Saturn 5 wind loads test program are analyzed to determine interference effects from the umbilical tower and vehicle. Considerable flow interference is shown for the mid-height levels, while the flow field is relatively unimpeded at the anemometer positions used at ground and extreme top levels. Numerical analyses are performed in addition to the experimental analysis to gain further insight to the relatively little understood interference effects in the local wind flow about the Saturn 5 launcher umbilical tower. Author

N68-21443*# National Aeronautics and Space Administration, Washington, D. C.
SURVEYOR 6. A PRELIMINARY REPORT
Mar. 1968 173 p refs
(NASA-SP-166) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Preliminary results of analyses of scientific data gathered during the Surveyor VI mission are reported. Assessed are the following: television observations from Surveyor VI; lunar surface mechanical properties; lunar surface temperatures and thermal characteristics; astronomical observations; chemical analyses of the moon at the Surveyor VI landing site; electromagnetic properties (magnet test); theory and processes relating to the lunar maria; and the selenographic location of Surveyor VI. S.C.W.

N68-21542*# Chrysler Corp., Huntsville, Ala. Space Div.
EVALUATION OF AS-203 LOW GRAVITY ORBITAL EXPERIMENT
13 Jan. 1967 211 p refs
(Contract NAS8-4016)
(NASA-CR-94045; HSM-R421-67; BB-3.4.3-5-101) CFSTI: HC $3.00/MF $0.65 CSCL 22D

This report presents the orbital flight results and detailed evaluation of the low gravity liquid hydrogen experiments conducted on the Saturn IB vehicle AS-203. The performance of various S-IVB stage subsystems and special low gravity instrumentation was also evaluated. This experiment verified that satisfactory performance can be obtained from the Saturn V/S-IVB propellant control and J-2 engine thermal conditioning systems. Additional information on heat transfer in a closed container and fluid behavior during rapid tank depressurization is also presented. Author

N68-21625# Aerospace Corp., El Segundo, Calif. Technical Operations.
STABILITY ANALYSIS OF DUAL-SPIN SATELLITES, JUNE 1966–MARCH 1967
D. L. Mingori Jul. 1967 92 p refs
(Contract F04695-67-C-0158)
(TR-0158(3133-02)-1; SAMSO-TR-68-66; AD-666022)

Two alternative analytical techniques, the direct method of Lyapunov and the application of Floquet theory to linear variational equations, are used to examine the behavior of dual-spin satellites. Both approaches are discussed briefly and then applied to several specific systems, some of which contain passive energy dissipating mechanisms. The results show that properly designed dual-spin satellites can be stable in spin about an axis of minimum or maximum moment of inertia even in the presence of energy dissipation. Author (TAB)

N68-21630*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE DECLINE AND FALL OF IMP 3: SECOND REPORT
Barbara E. Lowrey Feb. 1968 15 p refs
(NASA-TM-X-63164) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This report discusses the reentry of the IMP 3 satellite (Explorer 28). It is predicted that the satellite will reenter on July 5, shortly before 5 a.m. local time, over the Indian Ocean between the Maldive Islands and Ceylon. Further investigation has made possible a lowering of the error bounds of the reentry prediction. The time is estimated to be accurate within 10 minutes, and the latitude and longitude of the reentry track within 2-1/2°. The data has been rechecked and particularly bad points were found to be due to copying errors in all cases. Additional background information has been included to make the report more useful. Author

N68-21706# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DEVELOPMENT OF A GUIDED RECOVERABLE CARRIER SYSTEM FOR HIGH ALTITUDE INVESTIGATION. PARAGLIDER VERSION [ENTWICKLUNG EINES GEZIELT RUECKFUEHRBAREN TRAEGERSYSTEMS FUER HOEHEN-FORSCHUNG PARAGLEITERVERSION]
Bundesministerium fuer Wiss. Forsch. Sep. 1967 81 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-24) CFSTI: HC $3.00/MF $0.65

The system elements of the sounding rocket as paraglider, control facilities, air-frame, electronics of telemetry and telecommand, emergency recovery system, and air log are described. Details of construction are explained as well as the ground installations of telemetry and tracking. The comprehensive experiments in wind tunnel, simulator, and free flight, and the aerodynamic behavior of the rocket with unfolded paraglider are discussed. Author

N68-21743* Philco-Ford Corp., Newport Beach, Calif. Space and Re-Entry Systems Div.
ANALYSIS OF CONCEPTUAL DESIGNS FOR THE VOYAGER ENTRY CAPSULE
Gerald A. Cohen, Richard M. Foster, and Everett M. Schafer [1967] 190 p refs
(Contract NAS1-5554-1)
(NASA-CR-66580) CFSTI: $3.00 CSCL 22B

Entry trajectories were computed for 10 ft base diameter blunt cone and tension shell capsules with ballistic coefficients of approximately 0.2 slug/ft^2. In order to simulate the most severe conditions expected, entry was assumed to follow an attitude control failure resulting in uncontrolled tumbling at an initial rate of 0.1 rad/sec. From two sets of entry conditions and four model atmospheres, two critical trajectories are presented for each capsule. One provides critical time-integrated heating loads; the other, critical pressure loads and heating rates. Using the critical pressure distributions obtained in the flow field analysis, the elastic stress response and stability of the conical sandwich shell and skin-stiffened tension shell capsules were analyzed. Both 15 and 19 ft base diameters were considered for capsules with ballistic coefficients of approximately 0.2 slug/ft^2. Structural design changes were made until acceptable designs were achieved for both types of capsules. For the final designs, fundamental natural frequencies and vibration mode shapes were determined. Author

N68-21758*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN ANALYTICAL INVESTIGATION OF THE AERODYNAMIC AND PERFORMANCE CHARACTERISTICS OF AN UNPOWERED ROTOR ENTRY VEHICLE

Alan D. Levin and Ronald C. Smith Washington Apr. 1968 43 p refs

(NASA-TN-D-4537) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Analysis of the aerodynamic characteristics of a rotor in autorotative flight. These characteristics have been combined with those of a capsule to study the performance characteristics of a rotor entry vehicle. Performance parameters such as range, deceleration, and heating were determined for a vehicle entering the atmosphere from earth orbit. The effects of rotor to capsule diameter ratio on the entry parameters and the effect of delaying rotor deployment on the range capability were investigated. Substantial gains in lateral range can be obtained by the addition of a rotor to a lifting capsule while maximum deceleration changes very little. The aerodynamic heating on the rotor was found to be severe enough to require possibly delaying deployment of the rotor until after the peak heating region has been passed. Delaying rotor deployment reduced the lateral range capability. Author

N68-21780*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER VENUS 67 FLIGHT ACCEPTANCE PYROTECHNIC TEST

P. M. Barnett 15 Dec. 1967 94 p ref

(Contract NAS7-100)

(NASA-CR-94152; JPL-TR-32-1218) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Mariner Venus 67 spacecraft transient responses to the firing of pyrotechnic devices located on or near the spacecraft are presented in the form of transient-time histories and shock spectra. Acceleration transient response measurements at selected spacecraft locations were recorded for these pyrotechnic events. Relative severity, based on maximum shock spectra, of the various pyrotechnic events is discussed for different areas of the spacecraft. Data handling and analysis techniques are described. Comparisons are made between the responses of the M67-1 (flight support spacecraft) and M67-2 (Mariner V) spacecraft. Author

N68-21778*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT TEST OF A 30-FOOT-NOMINAL-DIAMETER CROSS PARACHUTE DEPLOYED AT A MACH NUMBER OF 1.57 AND A DYNAMIC PRESSURE OF 9.7 POUNDS PER SQUARE FOOT

John S. Preisser and Clinton V. Eckstrom Washington Apr. 1968 53 p refs

(NASA-TM-X-1542) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A 30-foot (9.1-meter) nominal-diameter cross-type parachute with a cloth area (reference area) of 709 square feet (65.9 square meters) was flight tested. The test parachute was ejected from an instrumented payload by means of a mortar when the system was at a Mach number of 1.57 and a dynamic pressure of 9.7 psf. The parachute deployed to suspension-line stretch in 0.44 second with a resulting snatch-force loading of 1100 pounds. Canopy inflation began at 0.58 second and a first full inflation was achieved at approximately 0.77 second. The maximum opening load occurred at 0.81 second and was 4255 pounds. Calculated values of axial-force coefficient during the deceleration portion of the test varied between 0.35 and 1.05, with an average value of 0.69. During descent, canopy-shape variations had reduced to small amplitudes and resultant pitch–yaw angles of the payload with respect to the local vertical averaged less than 10°. The effective drag coefficient, based on the vertical components of velocity and acceleration during system descent, was 0.78. An earlier test of a 25.2-foot nominal-diameter cross parachute is described in appendix A, along with a brief analysis of the riser-line failure suffered during the test. Author

N68-21820*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AEROBEE 350 ROCKET INSTRUMENTATION

C. D. Tackett Feb. 1968 120 p

(NASA-TM-X-63156; X-721-68-34) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A program designed to develop a new sounding rocket system, designated as Aerobee 350, and attitude control system, which would be capable of carrying a 150 pound payload (nominal weight) to an altitude of 290 statute miles, and would control the positioning of the payload in space is reported. Focused on are efforts resulting in the design and development of instrumentation and telemetry systems capable of measuring and transmitting vehicle acceleration, attitude and motion dynamics, propulsion pressure, and temperature of both payload and vehicle. Presented is a description of the instrumentation and telemetry systems used for these rockets, as well as of the ground equipment used at the Wallops Island ground stations to check out, receive, and record the telemetry data for the launches. S.C.W.

N68-21833*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE OF A 16.6-METER-DIAMETER CROSS PARACHUTE IN A SIMULATED MARTIAN ENVIRONMENT

Reginald R. Lundstrom, Wayne L. Darnell, and Lucille C. Coltrane Washington Apr. 1968 38 p refs

(NASA-TM-X-1543) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Inflation and drag characteristics of a 54.4-foot nominal-diameter cross parachute, deployed at a Mach number of 1.65 and a dynamic pressure of 12.68 lb/sq ft, were obtained from the fourth balloon-launched flight test of the planetary entry parachute program. These data as well as the stability characteristics of the parachute during subsonic descent are presented. After deployment the parachute quickly inflated to a full condition, partially collapsed, and then gradually reinflated while undergoing rapid oscillations between overinflation and underinflation. The oscillations began while the parachute was still at supersonic speeds and continued to low subsonic speeds well below an altitude of 90,000 feet. These canopy instabilities produced large cyclic variations in the parachute's drag coefficient. The average value of drag coefficient was about 0.8 to 0.9 at subsonic speeds and slightly lower at supersonic speeds. These drag coefficient values were based on the actual fabric surface area of the parachute canopy. The parachute sustained minor damage consisting of two canopy tears and abrasions and tears on the riser line. It is believed that this damage did not produce a significant change in the performance of the parachute. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-20584 California Univ., Los Angeles.
CREEP ANALYSIS OF AXISYMMETRIC BODIES
Gilbert Arnold Greenbaum (Ph.D. Thesis) 1966 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-6177

An analysis is developed for creep deformations in an arbitrary axisymmetric body of revolution subject to axisymmetric loads. Solutions are presented and discussed for thick-walled cylindrical pressure vessels with spherical, elliptical and flat end closures. The method of solution is an extension of the direct stiffness method. The body is replaced by a system of discrete triangular cross-section ring elements interconnected along circumferential nodal circles. The equations of equilibrium for the body are derived from the Principle of Minimum Potential Energy. The creep behavior of the body is formulated in terms of creep laws in current use. Starting with the elastic solution of the problem, creep strains are calculated for a small time increment. These creep strains are treated as initial strains to determine the new stress distribution at the end of the time interval. The procedure is repeated until either the final time is reached or until the stress distribution is not changed. Dissert. Abstr.

N68-20608 Maryland Univ., College Park.
TORSION CREEP OF CIRCULAR AND NON-CIRCULAR TUBES
Leonard Mordfin (Ph.D. Thesis) 1966 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-6127

A torsion creep theory for non-circular tubes was developed by applying the octahedral shear stress theory of multiaxial creep to a generalized version of Bredt's equations. To verify the theory, torsion creep tests were carried out on twelve large aluminum alloy drawn tubes, of four configurations, at 400°F. These represent the first torsion creep tests of non-circular tubes in the literature, and only the second torsion creep tests of full-sized structural members. In addition, fifteen tension creep tests of the tube materials were performed to evaluate the basic creep characteristics of the materials. For the calculation of torsion stresses in circular tubes the thin-wall approximation is shown to be adequate for thickness-to-radius ratios up to one-tenth. For straight-sided tubes equivalent accuracy is obtained for effective ratios up to only one-twentieth. These criteria are applicable under creep conditions as well as under elastic conditions. Dissert. Abstr.

N68-20625 California Univ., Berkeley.
THEORETICAL METHODS FOR ANALYSIS OF METAL DEFORMATION PROBLEMS
Aly Hossni Abd El Kader Shabaik (Ph.D. Thesis) 1966 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 66-15494

Theoretical and experimental flow fields of several extrusion ratios of lead extruded in plane strain were compared. It was found that for extrusion ratios where dead metal exists the agreement between the potential and experimental flow nets was better for small reductions when a modified boundary approaching a flow line was used. It was also found that when the flow changed direction gradually, the potential flow net was in good agreement with the experimental one. The general method of solution, which is not so simple as the potential theory, gave excellent results for all extrusion ratios. The flow lines and velocity components obtained theoretically and experimentally were compared and they were found to be identical in both cases. Solutions obtained from both methods, the potential theory and the general theory, are unique and complete. Dissert. Abstr.

N68-20626 California Univ., Berkeley.
A STUDY OF A MULTIPLE INTEGRAL REPRESENTATION OF THE CONSTITUTIVE EQUATION OF A NONLINEAR VISCOELASTIC SOLID
Vernon Valentine Neis (Ph.D. Thesis) 1966 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-5128

The applicability of a functional polynomial of third degree for the representation of the constitutive equation of a nonlinear viscoelastic polymer has been investigated. A method for the determination of the kernel functions appearing in the one-dimensional creep formulation based on the least-square criterion of curve fitting has been discussed. Creep measurements of tension and compression in low density polyethylene under single-step, two-step, and three-step loading histories are described. The analysis of this data has provided a basis for the determination of the creep kernel functions. For the loading range used in the tests, the Volterra–Fréchet multiple integral expansions of the constitutive functional of low-density polyethylene has been found to be adequately represented by the three term integral representation. A close comparison between the experimental response to these loading histories and the response predicted by the three term integral representation was obtained. Dissert. Abstr.

N68-20635 Illinois Univ., Urbana.
ANALYSIS OF ECCENTRICALLY STIFFENED SKEWED PLATE STRUCTURES
William Charles Gustafson (Ph.D. Thesis)
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6622

Many plate structures are stiffened with beams constructed integrally to the plate with centroids eccentric to the center of the plate. The usual assumption in the analysis of such structure is to modify the flexural stiffness of the beam to account for its eccentricity and then assume that the centroid of the modified beam coincides with the center of the plate. The attempt here is to eliminate the assumption and treat the stiffener as being eccentric. The approach chosen is a finite-element method where the continuum problem is approximated by an assemblage of quadrilateral elements connected at common vertices and assumed to deform according to preselected displacement functions. Stiffness matrices are derived for plate elements and eccentric stiffener elements; and these element stiffness matrices are assembled to approximate the real structure. A computer program using the finite-element method is developed to solve stiffened plate problems. Dissert. Abstr.

N68-20636 Princeton Univ., N. J.
AN INVESTIGATION OF ELASTIC BUCKLING IN CORRUGATED PLATES UNDER SHEARING STRESSES
Anthony Kobina Amos (Ph.D. Thesis) 1966 170 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-5700

An analytical model using the theory of thin shallow shells applied to a sinusoidally corrugated plate is set up leading to a pair of coupled fourth order partial differential equations in two dependent and two independent variables. Through perturbation of these equations and a comparison with the von Karman equations for a flat plate, it is shown that the deformations of the corrugated plate under load and the stresses resulting therefrom can be separated into "plate action" and "shell action" components. An approximate analysis is presented establishing a formula relating the

critical stress at local buckling of the corrugations to their geometric properties. A description of experimental investigations performed on both flat and corrugated panels is given. The results of the analytical and experimental studies for both the corrugated and equivalent flat plate are compared and shown to be in good agreement. Dissert. Abstr.

N68-20637 Illinois Univ., Urbana.
LARGE ELASTIC DEFORMATIONS AND SNAP-THROUGH OF SHALLOW DOUBLY CURVED SHELLS
Robert Hocquard Leicester (Ph.D. Thesis) 1966 245 p
Available from Univ. Microfilms: HC $11.05/MF $3.20 Order No. 67-6656

This study consists of an investigation by numerical analysis of the conventional elastic large-deformation equations of equilibrium of shallow shell structures, doubly curved and rectangular in planform. The displacements of the shells are approximated by truncated Fourier series. The coefficients of these series and the loading parameters are taken to be the coordinates of a "coefficient space." The solution of the shell equations can then be described by continuous curves in this coefficient space. These solution curves are traced continuously through the coefficient space by using a Newton–Raphson iteration procedure. Analyses are made of shells having positive, zero and negative Gaussian curvatures, subjected to both distributed and point loads. The solution curves in coefficient space are found to follow paths varying from simple and monotonic ones for thick shells with negative Gaussian curvature, to complex tortuous ones for thin shells with positive Gaussian curvature. Dissert. Abstr.

N68-20652 Purdue Univ., Lafayette, Ind.
REFLECTION OF PLANE WAVES FROM THE FLAT BOUNDARY OF A MICROPOLAR ELASTIC HALFSPACE
Vaughn Rupert Parfitt (Ph.D. Thesis) 1966 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-5481

This paper is concerned with the investigation of the effect of microstructure in the solution of several problems of wave propagation. The propagation of plane waves in a micropolar elastic half-space and their reflections from a stress-free flat surface are studied. It has been found that in a micropolar elastic solid six waves can exist traveling at four distinct speeds, three of which disappear below a critical frequency dependent upon the character of the medium. Reflection laws and amplitude ratios are presented for three specific problems. Dissert. Abstr.

N68-20680 Illinois Univ., Urbana.
A MORE EXACT THEORY OF FLEXURAL WAVE PROPAGATION IN ELASTIC BEAMS
Frank Hayes Brittain (Ph.D. Thesis) 1966 59 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6569

A new and more accurate theory of flexural wave propagation in homogeneous elastic beams of constant circular cross section is developed. This theory includes the effects of cross-sectional warping and distortion, both tacitly neglected in the Timoshenko beam. Cross-sectional warping and distortion refer to the nonproportionality of axial strains with the distance from the neutral axis and lateral effects respectively. The method used to obtain the four linear, second order, coupled partial differential equations of motion is a variation of the method of internal constraints due to Enricco Volterra. In addition to the above, some work has been done with the Pochhammer–Chree (exact) theory. Dispersion relations have been obtained in terms of phase velocity and frequency curves; the latter is given for both real and imaginary wave numbers. Also displacements associated with the Pochhammer–Chree theory have been obtained and plotted. Dissert. Abstr.

N68-20703 Purdue Univ., Lafayette, Ind.
AN APPROACH, USING PHOTOSTRESS, TO THE PLANE STRESS PROBLEM OF THE NARROW FACED SPUR GEAR TOOTH, VOLUMES 1 AND 2
Marion Giles Pottinger (Ph.D. Thesis) 1966 238 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-5484

Photostress was used as a strain transducer and the stress distribution was obtained by numerical stress separation techniques employing digital computer programs. The experimental techniques involved in this, the first known application of Photostress to any contact stress problem, were developed during this research. The problems of using Photostress materials were solved for static strain measurements, but not for dynamic strain measurements. Two cases were completely analyzed in this work: the pitch point contact of a set of three-diametral pitch and a set of four-diametral pitch spur gears both with gear ratio of one to one. In both cases the gears were case-hardened and lubricated. The results show no qualitative differences from plane transmission photoelastic results using plastic models. The two cases analyzed showed the Belajef solution for contact stresses of cylinders is applicable to spur gears under static conditions. Dissert. Abstr.

N68-20706 Illinois Univ., Urbana.
EVALUATION OF FLOW AND FRACTURE PROPENSITY OF NOTCHED STEEL PLATES BY MEANS OF A PHOTOELASTIC MODEL
John Parkinson Cannon (Ph.D. Thesis) 1966 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-6576

The object of this investigation was to gain a better understanding of the flow and fracture propensity of steel plates in which the Wells-type notch served as the fracture initiator. Very high strain concentrations were found to exist on the perimeter of the Wells notch with a maximum elastic concentration of the order of 13 occurring at the notch-tip. Severe constraint against plastic flow was found to exist a short distance from the tip of the Wells notch. This region is postulated to constitute a vicinity of increased susceptibility to cleavage type fracture. On the basis of the stresses found to exist in the Wells notch, three fracture initiation mode possibilities are postulated: (a) a shear mode, initiating at the notch-tip, leading to ductile fracture, (b) shear fracture, initiating at the notch-tip, converging into a cleavage fracture as the region of high triaxiality becomes involved in the fracture process, and (c) cleavage fracture initiating in the region of high triaxiality away from the notch-tip. Dissert. Abstr.

N68-20721# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ICE CAP STRAINS AND SOME EFFECTS ON ENGINEERING STRUCTURES
Malcolm Mellor and Sherwood Reed Dec. 1967 28 p refs
(CRREL-TR-202; AD-665373)

The components of strain for the upper layers of ice sheets are given in terms of ice flow velocity and snow accumulation rate. Methods of estimating the components of strain rate which are necessary for design of engineering structures are outlined, and representative measured values are given. The relation between observed structural deformation and ice cap straining is discussed. Author (TAB)

N68-20727# Air Force Systems Command, Los Angeles, Calif.
NATURAL FREQUENCIES AND MODE SHAPES OF THE TRANCATED CONICAL SHELL WITH FREE EDGES
Frederick A. Krause (Ph.D. Thesis—Arizona Univ.) Jan. 1968 99 p refs
(SAMSO-TR-68-37; AD-665828)

Results from experimental studies concerning the natural frequencies and mode shapes of the thin truncated conical shell with free edges have not been consistent. Mode shapes from one study were found to have an equal number of nodes at the two free edges when vibrating in a given mode while in contrast a second study revealed an unequal number of nodes at the two cone edges. The theoretical results presented in this study are obtained through the use of a modified Galerkin procedure and are in agreement with the equal node experimental data. At the same time, the theoretical results have been used as a basis for explaining the opposing experimental data. Author (TAB)

N68-20729 Northwestern Univ., Evanston, Ill.
SOME TORSION PROBLEMS IN ELASTICITY
Neil Julian Freeman (Ph.D. Thesis) 1966 44 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-4221

Two mixed boundary value problems of the three-dimensional theory of elasticity are investigated. Both are reduced to the soution of Fredholm integral equations. First, the torsional deformation of an elastic rod perfectly adhering to an elastic half-space is considered. The curved surface of the cylinder and the plane surface of the half-space are assumed stress-free. To satisfy the mixed boundary conditions of this problem, certain dual integral equations are encountered. The second problem considered is the torsion of two finite, coaxial, circular cylinders (dissimilar materials) in contact. The problem is solved on the assumptions that the base of one cylinder is rigidly fixed while the top of the other cylinder is forced to rotate, and that the curved surface of each cylinder is stress-free. Analytical expressions for the shear stress and torque are found for both problems, enabling direct comparison with classical limiting cases. Dissert. Abstr.

N68-20779# Princeton Univ., N. J. Frick Chemical Lab.
VISCOSITY AS A FUNCTION OF SHEAR RATE
Arthur V. Tobolsky, L. Lawrence Chapoy, and I. L. Hopkins Jan. 1968 6 p refs
(Contract Nonr-1858(07))
(RLT-104; AD-665308)

A paper is presented in which polymer viscosity is derived as a function of rate of shear. The basic idea introduced is that the polymer attains a limiting strain in the melt viscosity instrument. This limiting strain is perhaps a breaking strain. Author (TAB)

N68-20794# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF COMPOSITE STRUCTURAL MATERIALS FOR HIGH TEMPERATURE APPLICATIONS Final Report, 22 Nov. 1966–22 Nov. 1967
J. Chorne, C. A. Bruch, R. Jakas, and W. H. Sutton Washington Naval Air Systems Command Jan. 1968 166 p refs
(Contract N00019-67-C-0243)
(AD-665810)

The purpose of the study is the development of new structural composite materials having a high strength-to-weight ratio at elevated temperature. Major emphasis was placed on evaluating factors important to two potential processes for making high strength composites; high temperature pressure-bonding of electroplated whisker bundles (EP/PB), and liquid metal infiltration. Work was also performed on whisker growth, coating, and processing. Author (TAB)

N68-20852 Illinois Univ., Urbana.
APPLICATIONS OF SYMBOLIC NETWORK-TOPOLOGICAL METHODS TO STRUCTURAL ANALYSIS AND DESIGN
Dennis Roy Lagerquist (Ph.D. Thesis) 1966 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-6652

This study considers the use of topological formulas, which have recently been applied to network synthesis. These formulas express relationships between behavior variables of a system directly from the system topology described by a linear graph. By means of topological equations, these expression can be obtained in symbolic form in terms of the system components. The lumped-parameter dynamic problem is formulated in terms of network concepts. This formulation can also be used to treat certain distributed mass problems. The Laplace transformation technique is used to express the dynamic relationships in operational form, so that algebraic operations can be used in the topological equations. A procedure for designing vibrational systems is formulated in order to illustrate the use of the topological equations in the design process. A computer program is developed to perform the necessary computations for the analysis and design problems considered. Dissert. Abstr.

N68-20862# Drexel Inst. of Tech., Philadelphia, Pa. Wave Propagation Research Center
MCDIT 1: A COMPUTER CODE FOR ONE-DIMENSIONAL IMPACT PROBLEMS
Bruce P. Burns Dec. 1967 42 p refs
(Contract DA-18-001-AMC-876(X))
(Rept.-125-11; AD-665815)

The computer programs for like material one-dimensional impact problems are presented. The problems are solved by applying the method of characteristics to metals following a specific equation of state and to an ideal gas. Detailed instructions for the use of the programs and the limitations of the programs are given. Author (TAB)

N68-20863# Naval Weapons Lab., Dahlgren, Va.
A STRETCH COMPUTER PROGRAM WHICH COMPUTES THE CENTER OF GRAVITY, THE SHEARING FORCES, AND THE BENDING MOMENTS OF AIRCRAFT STRUCTURES TREATED AS STATICALLY DETERMINATE BEAMS
Clifton G. Chappell Dec. 1967 32 p
(NWL-T-19/67; AD-665776)

The memorandum describes a STRETCH computer program written in FORTRAN IV which computes the center of gravity, the gross weight, the shearing forces, and the bending moments of certain aircraft structures, viz., those which can be treated as statically determinate beams. The program also outputs, on option, graphic data in the form of shear diagrams and bending moment diagrams. Author (TAB)

N68-20866# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
RANDOM VIBRATION OF LINEAR STRUCTURES
M. Shinozuka and J. N. Yang Nov. 1967 61 p refs
(Contracts Nonr-266(91))
(TR-53; AD-665305)

Systematic methods are presented for the determination of the dynamic characteristics of linear structures; geometric configuration of structures are taken into account with the aid of the linear graph concept, which permits a convenient use of a digital computer. The methods can be applied to the analysis of complex structures with distributed mass as well as to the analysis of discrete mass structures. A numerical method of the single and double inversion of the Fourier transform is presented. This makes the frequency domain analysis of nonstationary random vibrations tractable. These methods are not only of theoretical interest but also provide informations needed for estimation of structural reliability. Author (TAB)

N68-20918 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON NONLINEAR OSCILLATIONS OF A PLATE [O NELINEYNYKH KOLEBANIYAKH PLASTINKI]

L. F. Schulezhko *In its* Approximate Methods of Soln. of Differential Equations 15 May 1967 p 181–195 refs (See N68-20901 11-19)

Consideration is given to a thin rectangular plate, two edges of which are simply supported and under the influence of evenly distributed forces and bending moments, and the other two of which are rigidly fastened. The problem of the dynamic stability of such a plate in nonlinear formulation is reduced to the solution of a nonlinear system of partial differential equations. Author

N68-20934# California Univ., Livermore. Lawrence Radiation Lab.

COMPUTER SIMULATION OF A HIGH SPEED TENSION TEST

David J. Shippy (Kentucky Univ.), Peter P. Gillis (Kentucky Univ.), and Kenneth G. Hoge [1967] 27 p refs Presented at the 6th Intern. Symp. on High Speed Testing, Boston, 6–7 Mar. 1967

(Contract W-7405-ENG-48)

(UCRL-13226; CONF-670329-1) CFSTI: HC $3.00/MF $0.65

In order to gain insight into the vibrational response of a load cell coupling a tensile specimen and a high speed testing machine a relatively simple mass-spring system was studied. The machine and load cell are represented by linear springs and the specimen by a nonlinear spring that closely models the static stress–strain behavior of many metals. These are connected in series with two masses representing the testing machine and the load cell–specimen combination. It is assumed that during a test the ends of this mass-spring series separate at a constant velocity. Numerical analysis of the system was carried out on a digital computer using values considered appropriate for such tests. Since the system has two degrees of freedom two vibrational modes were observed corresponding approximately to the natural frequencies of the machine and load cell. Vibrational amplitudes were usually of the same order of magnitude in the two modes. While the study was designed primarily to investigate the effects of specimen characteristics on load cell response, the most interesting result was that the period of the low frequency vibrational mode will usually be long compared with the time required for the specimen to fracture. This implies that the high frequency vibrations can have a mean value displaced in a given direction (by superposition on the low frequency mode) from the specimen force during the entire test. Author (NSA)

N68-20954*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL MODES OF VIBRATION OF 14° CONICAL-FRUSTUM SHELLS WITH FREE ENDS

John S. Mixson Washington Apr. 1968 18 p refs

(NASA-TN-D-4428) CFSTI: HC $3.00/MF $0.65 CSCL 20K

In experimental studies of the vibrations of conical and cylindrical shells, some modes having different numbers of circumferential waves at different locations along the shell meridian have been obtained. (Such modes are termed "mixed modes" herein.) To investigate the occurrence of such modes, five conical-frustum shells were vibrated and their resonant frequencies and nodal patterns determined. The shells had a half-angle of 14° and three wall thicknesses. Three shells had butt-welded seams and two had lap-welded seams. The suspension-system stiffness was varied, and two types of excitation were used. Experimentally determined frequencies and the location of the circumferential node line are shown to be in good agreement at low frequencies with values calculated by means of inextensional shell theory. Mixed modes occurred when the shell or test setup departed substantially from ideal conditions. Examples of nonideal conditions include imperfections or lap-welded seams on the shell, stiff suspension systems, and forced response of two modes at nearly the same frequency. It is shown that the experimental nodal patterns of these modes can be obtained by superposition of theoretical modes of an ideal conical shell. Author

N68-20993 Illinois Univ., Urbana.

DISTRIBUTION OF STRESSES AND PARTITION OF LOADS IN GUSSETED CONNECTIONS

Peter Christian Birkemoe (Ph.D. Thesis) 1966 151 p

Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-6560

This study presents a basic analysis of various physical parameters and their effects on load partition and stress distribution in gusseted connections. Analytically, two elastic joint problems were studied: (1) the attachment of a tension member by a single row of fasteners to a semi-infinite plate, (2) the similar attachment to a symmetrical tapered gusset plate. It was found that, individually, many of the joint parameters did not appreciably affect the load partition in the connection; however, cumulatively they could have detrimental effects. The finite geometry plate, studied experimentally, was fabricated and tested with variable geometry or taper of the gusset plate; the plate was loaded by lap plates connected by tight fitting pins. Geometry did not appreciably affect the load partition until extreme geometries, which resulted in a change of the gusset net cross-sectional area, were reached. Dissert. Abstr.

N68-20995*# Benson (Robert W.) and Associates, Inc., Nashville, Tenn.

EVALUATION OF SIMULATION PROCEDURES FOR HIGH INTENSITY NOISE FIELDS Final Report

1 Apr. 1968 44 p refs

(Contract NAS1-6906)

(NASA-CR-66576) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An experimental program has been conducted to determine those aspects of a sound field which correlate with motion of a structure excited at one of its modes of vibration. It has been demonstrated that the forcing function for a structure is the instantaneous differential pressure existing across the structure. A measurement of pressure gradient or particle velocity as vector quantities therefore correlates with the observed motion. Actual sound fields surrounding typical high intensity noise sources are not described in a manner which allows for a direct evaluation of all simulation facilities. Most facilities require additional measurements in order to determine their adequacy. Author

N68-21034# Oak Ridge National Lab., Tenn.

SIMPLIFIED CALCULATIONS FOR SMALL DEFLECTIONS IN WALLS OF RADIO FREQUENCY CAVITIES

L. N. Howell Jan. 1968 63 p

(Contract W-7405-ENG-26)

(ORNL-TM-1990) CFSTI: HC $3.00/MF $0.65

The elastic behavior of two types of radio frequency cavities considered for a separated orbit cyclotron was analyzed to determine whether or not the magnitude and distribution of the deflections in the walls of the cavities caused by atmospheric loading can be predicted and controlled. Expressions were derived for the elastic curves that describe the deflections in the walls, and methods were devised to study the structural parameters: the size, shape, wall thickness, and size and spacing of the stiffeners. Computer programs were written to perform the numerical calculations, and these methods of analysis were applied to different design conditions. It was concluded that flexural rigidities can be made to vary as required to obtain specific deflection patterns, but this principle is difficult to apply to any degree for the conditions and purpose considered. NSA

N68-21056 Arizona Univ., Tucson.
THE DETERMINATION OF THE SHAPE AND THICKNESS OF A THIN MINIMUM WEIGHT SHELL
Celal Nizamettin Koestem (Ph.D. Thesis) 1966 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-3961

It is assumed that the shell is filled to the top with a liquid, and is simply supported at the top by a ring of a given radius. Maximum depth of the shell is also given. To obtain a solution, a curvilinear coordinate system is used with the arc length taken as the independent variable. As a result of the rotational symmetry of the shell, the configuration of the three dimensional geometry is transformed into the configuration of the two dimensional generator. The shell material is regarded as ductile and Von Mises failure criterion is utilized in determination of the thickness-stress relation. By using the Lagrangian multiplier method and the Euler equations of calculus of variations the problem is simplified to a system of ordinary nonlinear simultaneous differential equations. The physical problem, which is a boundary value problem, is treated as an initial value problem by using a fourth order Runge–Kutta numerical integration scheme. The values obtained at the terminal point deviate from the required values. To satisfy the constraints at the terminal point, initial values are adjusted by using the Newton–Raphson method. Until the correct values at the terminal point are reached, the integration and the Newton–Raphson method are repeated. For the numerical solution a FORTRAN program is developed. Dissert. Abstr.

N68-21099*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL STUDY OF AEROELASTIC INSTABILITY OF OVEREXPANDED ROCKET NOZZLE EXTENSIONS
W. J. Tuovila and Norman S. Land Washington Apr. 1968 18 p refs
(NASA-TN-D-4471) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A brief exploratory investigation was conducted to study possible aeroelastic-instability phenomena which might occur for overexpanded flow through flexible nozzle extensions which are being considered for use in increasing the thrust of rocket engines at very high altitudes. Five conical extensions with a 22.5° half-angle and area ratios of 54 and 100 were fabricated from varying thicknesses of steel and glass-fiber laminates. Studies were conducted at constant stagnation pressure. Flow through the nozzle and extension started in an underexpanded condition but gradually changed to an overexpanded condition as the quiescent-flow ambient pressure increased. Two rigid aluminum-alloy models with geometry similar to that of the flexible models were used for pressure measurements and for visualization of flow across the exit and interior surface. For some flexible extensions, dynamic instability was observed which could be related by means of flow measurements to an overexpanded flow condition that caused buckling loads. The experimental data are summarized graphically to indicate nozzle-extension parameters in the stable region for different loading conditions. The data may be useful as a guide for the preliminary design of nozzle extensions. Author

N68-21103 California Univ., Berkeley.
AN INVESTIGATION OF THE CHARACTERISTICS OF AN ELECTRO-DYNAMIC VIBRATION DAMPER
Abdulhadi Kobaisi Abu-Akeel (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4984

A new type of dynamic vibration absorber is introduced, and its theory is derived and verified experimentally. The absorber utilizes an electric armature elastically coupled to its magnetic field stator. The stator is fixed to the vibrating system. The electric energy generated from the oscillations of the armature in its magnetic field is discharged through an electric network. The mechanical construction of this absorber resembles a dynamic spring-mass vibration absorber but the fine frequency tuning and damping are accomplished by the proper choice of the parameters of the electric network. Dissert. Abstr.

N68-21115# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ON THE VARIATIONAL THEOREMS OF ELASTIC-PLASTIC MEDIA
Germano Di Leonardo 1 Mar. 1967 42 p refs
(Rept.-67SD226)

A review of the elastic-plastic equilibrium equations and of the characteristic energy functionals related to an initially continuous body system is presented. It follows a unified variational formulation of the equations of the elastic-plastic field. The result shows that equilibrium and compatibility equations are characterized by a variation formulation. In addition it is found that the energy functionals introduced in the analysis do not possess variational properties with respect to any violation of the plasticity laws. Author

N68-21121*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ULTRASONIC DETECTION AND MEASUREMENT OF FATIGUE CRACKS IN NOTCHED SPECIMENS
S. J. Klima and J. C. Freche Washington 1968 34 p refs
To be Presented at the Fall Meeting of The Soc. for Exptl. Stress Analysis, San Francisco, 28 Oct.–1 Nov. 1968
(NASA-TM-X-52421) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An ultrasonic technique was developed and used to observe the formation and growth of fatigue cracks in notched cylindrical specimens subjected to reversed axial cyclic loading. Fatigue curves of life-to-initial detectable cracks as well as life-to-fracture were obtained for an aluminum, a titanium, and a cobalt base alloy as well as a maraging steel. Depth of initially detectable cracks ranged between approximately 0.0005 and 0.004 inch (0.013 and 0.10 mm). Curves were also obtained relating ultrasonic system output-voltage to crack depth up to 0.030 inch (0.76 mm) for three materials. These curves were used to demonstrate the capability of the device for monitoring crack growth. Author

N68-21163# Texas Univ., Austin. Center for Highway Research.
A FINITE-ELEMENT ANALYSIS OF STRUCTURAL FRAMES
T. Allen Haliburton and Hudson Matlock Jul. 1967 154 p refs
Prepared in Cooperation with Bureau of Public Roads
(RR-56-7; PB-176387) CFSTI: HC $3.00/MF $0.65

A rational method for computer analysis of rectangular plane frames is presented. Three degrees of freedom are allowed at each joint. Flexural stiffness, transverse and axial load, and foundation spring restraint are allowed to vary as desired along each frame member. Loads, couples and restraints can also be specified at each joint. Equations which mathematically describe a bar and spring model of the real frame are formulated. An iterative procedure is used to solve these equations. Each iteration involves a complete solution of the mathematical frame model, consisting of a stiffness matrix solution, using an efficient recursive technique, for the deflected shape of the frame in bending and a solution for the axial tension or compression in each frame member. Procedures for computer solution of the equations describing frame behavior are developed and convergence of the computer solution is discussed. Comparison is made with results developed by accepted theory and solutions of realistic example problems are presented. Author

N68-21164# Texas Univ., Austin. Center for Highway Research.
A FINITE-ELEMENT METHOD FOR TRANSVERSE VIBRATIONS OF BEAMS AND PLATES

Harold Salani and Hudson Matlock Jun. 1967 112 p refs
Prepared in cooperation with Bureau of Public Roads
(RR-56-8; PB-176388) CFSTI: HC $3.00/MF $0.65

A finite-element method is developed to determine the transverse linear deflections of a vibrating beam or plate. The method can be used to obtain numerical solutions to varied beam and plate vibration problems which can not be readily solved by other known methods. The solutions for the beam and plate are separate formulations which have been programmed for a digital computer. Both solutions permit arbitrary variations in bending stiffness, mass density and dynamic loading. The static equations have been included in the development so that the initial deflections can be conveniently established. In the beam, the difference equations are solved by a recursive procedure. For the plate, the same procedure is combined with an alternating-direction technique to obtain an iterated solution. The numerical results demonstrate that the method is applicable to a wide range of vibration problems which are relevant to a beam or plate. Author

N68-21218*# Linde Co., Tonawanda, N. Y.
LIGHTWEIGHT MULTILAYER INSULATION SYSTEM Final Report
C. R. Lindquist and G. E. Nies 23 Feb. 1968 194 p refs
(Contract NAS3-7953)
(NASA-CR-72363) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The development work necessary to achieve low thermal conductivity and good gas conductance in self-evacuating multilayer insulation panel systems for liquid hydrogen space tankage is described. Tests of a prototype system applied to a 30-inch diameter calorimeter tank resulted in a heat flux in liquid hydrogen service of 0.63 Btu/hr. $ft.^2$ for an in space condition and only 10 Btu/hr-$ft.^2$ during ground hold. Conceptual designs for insulation systems for various shaped tanks and specifically a preliminary design for an 82.6 inch diameter spherical tank are presented. Author

N68-21256# Chalmers Univ. of Technology, Goteborg (Sweden).
ON THE AXISYMMETRIC COLLAPSE OF CYLINDRICAL SHELLS UNDER EXTERNAL HYDROSTATIC PRESSURE
S. D. Lee 1967 30 p refs
(Rept.-314) CFSTI: HC $3.00/MF $0.65

The classic method of von Kármán for the determination of the maximum allowable eccentrically applied axial load of an inelastic column has been extended to analyze a cylindrical shell, stiffened by uniformly spaced transverse rings and subjected to external hydrostatic pressure, for plastic collapse in the axsymmetric mode. In the analysis strain-hardening of the material is neglected and a modified one-point collocation is used in satisfying the governing differential equations for the plastic range. Expression for the plastic axisymmetric collapse pressure is obtained and presented in graphical form. A criterion of thickness of shell for "moderately thick" and "thin" cylinder is presented; for "thin" cylinder an asymmetric lobar buckling mode will cause collapse. Finally, existing experimental results are compared with the theory. Author

N68-21283# Royal Aircraft Establishment, Farnborough (England).
OPTIMUM TAPERS FOR ECCENTRICALLY LOADED TIES
E. H. Mansfield Nov. 1966 17 p
(RAE-TR-66365) CFSTI: $3.00

A long untapered tie under tension exhibits localized stress concentrations when one end is subjected to a flexural rotation. These stress concentrations can be avoided by tapering the tie. The optimum tapers for ties of circular and rectangular section are determined, and the resultant flexural stiffnesses are compared with those of untapered ties. Results are of interest in the design of certain satellite model support systems. Author

N68-21293*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PENETRATION OF POROUS PROJECTILES IN ALUMINUM AND PLASTIC TARGETS
Richard H. Fish Washington Apr. 1968 11 p refs
(NASA-TN-D-4505) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Cylindrical projectiles of polyurethane plastic, with a fineness ratio of 2/3 and densities ranging from 1.17 gm/cc for the solid material to 0.065 gm/cc for the lightest porous material, impacted targets of 2024-T351 aluminum alloy and polycarbonate plastic at velocities from 3.45 to 7.08 km/sec. Solid projectiles with the fineness ratio appropriately reduced to give the same mass as some of the porous projectiles were also tested for comparison with the porous projectiles. The results of the investigation indicated that the solid projectiles penetrated as deeply as the porous projectiles of the same mass, but their crater shapes and volumes were different. The depths of penetration in the two different target materials could be correlated on the basis of the density ratio raised to the 2/3 power, without considering other physical properties such as strength. Comparison of the data of the present investigation with other plastic-projectile data indicated that the present data fall in low-speed or transition regions of impact. Author

N68-21299# Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.
A METHOD FOR DETERMINING THE THERMAL AND athermal COMPONENTS OF FLOW STRESS FROM STRESS RELAXATION
P. Rodriguez 1967 9 p refs
(BARC-313) CFSTI: HC $3.00/MF $0.65

Annealed sheet specimens of polycrystalline niobium were used to determine the thermal component values of flow stress at various temperatures from yield and flow stress measurements and also from stress relaxation experiments. Tensile tests were carried out at a strain rate of 6.67×10^{-5} sec at various temperatures ranging from 77° to 448°K, and the stress–strain curves obtained are shown. Another set of tensile tests was carried out in which the cross-head movement was stopped at various strain levels during the tensile tests and stress was allowed to relax. The stress at which relaxation rate became insignificant was designated, and the stress relaxation at various strain levels was determined. It is concluded that the stress relaxation technique is helpful in evaluating the thermal component of stress and the stress at which relaxation rate becomes insignificant. B.S.D.

N68-21301# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
EXPERIMENTAL INVESTIGATION OF THE BUCKLING BEHAVIOUR OF CIRCULAR CYLINDRICAL SHELLS WITH ECCENTRIC LONGITUDINAL STIFFENERS [EXPERIMENTELLE UNTERSUCHUNG DES BEULVERHALTENS VON KREISZYLINDERSCHALEN MIT EXZENTRISCHEN LAENGSUERSTEIFUNGEN]
H.-D. Garkisch Jan. 1967 54 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-75) CFSTI: HC $3.00/MF $0.65

Results from an experimental study of the effect of the eccentricity of stiffeners on the buckling load of circular cylindrical shells loaded in axial compression or hydrostatic pressure will be reported and are compared with theoretical buckling loads. The tests were performed with two outside and two inside stringer stiffened cylinders for each length. In the theory the buckling load is considerably higher for an externally stiffened cylinder than for an internally stiffened cylinder. Experiments show a smaller difference between the buckling loads of internally and externally stiffened cylinders. The postbuckling behavior of the stiffened cylinders reveals that due to the influence of predeformations the buckling load of an externally stiffened cylinder is more decreased than the buckling load of an internally stiffened cylinder. Author

N68-21310# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

ANALYSIS OF AN ANNULAR PLATE SUBJECTED TO A CONCENTRATED LOAD

Martin A. Goldberg, Thaddeus L. Hoffa, and Joseph Gorga Feb. 1968 44 p refs

(Contract Nonr-839(39))

(PIBAL-68-2; AD-666101)

An annular plate, clamped at the outer boundary, free of tractions and support at the inner boundary, and subjected to an eccentrically located concentrated load is examined in detail. Extensive computational results of the maximum deflection, radial moment, and circumferential moment associated with the radial location of the load and for a range of the inner to outer radius ratio are presented graphically. Author (TAB)

N68-21319*# General Dynamics/Convair, San Diego, Calif.

A MONOGRAPH ON DETERMINATION OF LONGITUDINAL VIBRATION MODES

J. A. Staley May 1967 66 p refs

(Contract NAS8-11486)

(NASA-CR-61707; GD/C-BTD-67-053) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Elastic longitudinal models of space launch vehicles are discussed for use in the determination of the dynamic characteristics needed for the analysis of response and stability for both multistage liquid and solid propellant vehicles and vehicles with clustered tanks. A mathematical model was formulated for the vehicle, and mass and stiffness model properties were established from the corresponding vehicle properties and normal modes of the model were determined. Details are included for the model requirements and the recommended procedure; as well as for the stiffness, flexibility, transformed mass matrices, solution for characteristics, and modal synthesis. Lumped mass models are adequate for determining lowest modal properties for liquid propellant launch vehicles with thin-skinned cylindrical shells; for more complex tank geometries, finite shell elements may be needed. Models of solid propellant rockets may be obtained by either continuous representation of the core and casing or by a simple model that accounts for the mass and shear stiffness of the solid propellant core. M.W.R.

N68-21322*# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.

THE USE OF EIGENFUNCTION EXPANSIONS IN THE GENERAL SOLUTION OF THREE-DIMENSIONAL CRACK PROBLEMS

R. J. Hartranft and G. C. Sih Feb. 1968 58 p refs

(Grant NGR-39-007-025)

(NASA-CR-94085; TR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A method is proposed whereby, using eigenfunction expansions, the complete three-dimensional stress and displacement expressions are developed in series form for the problem of an infinite solid weakened by a plane of discontinuity or crack. A suitable coordinate system is selected so that the general solution can be expressed independently of uncertainties of both nature of the applied loads and of the stress variations in the direction parallel to the crack edge. The unbounded contributions to the stresses can be shown clearly in a finite number of terms of the series solution, and they are found to vary as the inverse square root of the distance from the crack front. Inside a small region around the crack edge, the state of affairs reduces to that of plane strain in the two-dimensional case. Author

N68-21324 Institution of Mechanical Engineers, London (England).

MECHANICAL ENGINEERING SCIENCE, MONOGRAPH NUMBER 6

Dec. 1967 40 p refs

The structural vibration modes of the radio telescope were observed in resonance and free vibration tests using the excitation provided by the telescope's driving system. The vibration measuring system and the experimental procedure are described, and results are given for torsional modes about the azimuth axis, the rocking modes in the elevation and lateral planes, the cantilever flexural mode of the master column, and the walking mode of the counterweights. Dynamic load observations were also made between the turret base and the azimuth track. The telescope is controlled by a master equatorial which defines the pointing direction, and an error detector which detects the discrepancy between the nominated and the actual pointing direction of the dish. The effect of structural resonances on the error detector is examined. Experiments showed that the error detector motion was determined by its position in relation to the telescope's vibration mode shape and that there was a coupled motion of the master equatorial due to imperfect isolation of the master column from the telescope. R.N.A.

N68-21340# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AXISYMMETRIC BEND AND STABILITY OF TRIPLE LAYER ROUND PLATES WITH LIGHT FILLER [OSESIMMETRICHIYY IZGIB I USTOYCHIVOST'TREKHSLOYNYKH KRUGLYKH PLASTIN S LEGKIM ZAPOLNITELEM]

N. K. Galimov 11 Aug. 1967 17 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 1, no. 1, 1965 p 77–85

(FTD-HT-66-528; AD-666492)

The axisymmetric deflection of a triple-layered plate under transverse and longitudinal loads was investigated analytically. In part one, the case of transverse load deflection is considered. The governing equilibrium displacement equations are written in polar coordinates for uniform plate deflection w. The solution is discussed for three types of boundary conditions: plate fixed along its circumference, the two supporting layers hinged, and the freely supported plate. In part two, the bending is studied under the simultaneous action of a uniformly distributed load and a compressive force T, acting on the plate edges. The solution is given for a freely supported plate, the plate freely supported on the edges but with no displacement. Finally, in part three, the stability of the circular plate is studied under a compressive force. The solution is given graphically, and it is shown that the critical load depends on the boundary conditions used. Author (TAB)

N68-21360# Southampton Univ. (England). Inst. of Sound and Vibration Research.

RESPONSE OF TALL STRUCTURES TO ATMOSPHERIC TURBULENCE

K. N. Handa Dec. 1967 70 p refs

(TR-4)

A mathematical model is given for determining the effect of atmospheric turbulence on tall slender structures. The normal mode method is used to compute displacement response spectral density of a cantilevered chimney having a circular cross section of variable thickness along its length. The forcing function includes only the effect of random turbulence. The general expression for displacement consists of the two series. The first series gives the effect of the individual modes and the second series contains cross mode terms. It is assumed that the system is lightly damped and damping coupling of the normal modes is assumed to be negligible. Contributions from some second order terms are evaluated. The effect of the rate of change of turbulent air velocity is also included in the general formulation. A numerical example giving the estimated response of a tapered chimney, 650 ft tall, is presented. Author

N68-21389# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
GIRDER WEB BOUNDARY STRESSES AND FATIGUE Progress Report
J. A. Mueller and B. T. Yen Jul. 1967 84 p refs
(Rept.-327.2; PB-176712) CFSTI: HC$3.00/MF$0.65

The objective of the report is to define the primary cause of fatigue cracks observed in the webs of welded plate girder test specimens. The in-plane membrane stresses, which conformed reasonably well to beam theory predictions at the panel boundaries, are shown to have little connection with the occurrence of fatigue cracks, except in the tension region of panels under pure bending. The plate bending stress is then examined and a method of calculating these stresses through use of measured web deflections is developed. By taking into account the torsional rigidities of the flanges and transverse stiffeners, a partial differential equation is established as the necessary condition to ensure equilibrium and compatibility between the web and its bounding elements. The subsequent solution of the equation is performed through the use of the finite difference technique. The accuracy of the resulting plate bending stresses is then examined. In comparison with stresses computed from measured strains, the method is proven reliable. It is shown that fatigue cracks always initiated at the points of maximum plate bending stress, that the sequence of crack formation on a single test girder is readily explained by these stresses and that a typical S–N distribution is obtained when the fatigue data of several girders are compared. It is concluded that the plate bending stress is a primary cause of fatigue cracks in thin-web welded plate girders. Author

N68-21393# California Univ., Berkeley. Div. of Applied Mechanics.
THE LINEAR ELASTIC COSSERAT SURFACE AND SHELL THEORY
A. E. Green (Newcastle Univ.) and P. M. Naghdi Nov. 1967 26 p refs
(Contract Nonr-222(69))
(AM-67-14; AD-666103)

The linearized theory of an elastic Cosserat surface is discussed emphasizing its relevance to the classical problem of the linear theory of elastic shells (and plates) regarded as three dimensional bodies. Author (TAB)

N68-21394# California Univ., Berkeley. Div. of Applied Mechanics.
A NOTE ON SIMPLE DIPOLAR STRESSES
A. E. Green (Newcastle Univ.) and P. M. Naghdi Dec. 1967 22 p refs
(Contract Nonr-222(69))
(AM-67-15; AD-666104)

In the theory of simple force and stress dipoles (within the framework of the simple multipolar theory of Green and Rivlin) the anti-symmetric part of dipolar stresses make no contribution to the equations of motion or to the energy equation and are not determined by a free energy function. Here, the significance of these stresses (in a complete theory) is further discussed with reference to a simple example of torsion of a circular cylinder of an elastic material. Author (TAB)

N68-21395# Naval Postgraduate School, Monterey, Calif.
VISCOELASTIC FRACTURE: AN EXPOSITORY TREATMENT OF POLYMER FAILURE
Gerald H. Lindsey 1 Nov. 1967 115 p refs
(NPS-57L17111A; AD-666316)

Fracture in viscoelastic materials is discussed here as an extension of elastic fracture. Using continuum theory, three approaches are treated in detail, including energy failure surfaces and cumulative damage. Typical experimental work is reported to demonstrate its impact on the theories; however much more experimental work was omitted than was included. The attempt and purpose was to discuss in detail the fundamentals of the subject, and then subsequently build upon that with samplings of experimental results. The concluding section on the classical works dealing with stress analysis of crack geometries is for the purpose of comparison and unification. How these analyses relate to the energy theories is the basis of comparison. Author (TAB)

N68-21412# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
ULTIMATE FLEXURAL BOND IN BEAMS PRE-TENSIONED WITH HIGH-STRENGTH STRAND Progress Report
Robert Badaliance and David A. Van Horn Feb. 1966 88 p refs
(Rept.-309.1; PR-1; PB-176711) CFSTI: HC$3.00/MF$0.65

The study is an investigation of the bond characteristics of 1/2-in. 270K prestressing strand. The primary objective was to determine the effect of embedment length on the axial stress necessary to produce general bond slip. The principal variable in the investigation was the embedment length of the strand. The results of thirteen tests conducted on twelve beams pre-tensioned with 1/2-in. 270K strand are presented and compared with the test results obtained by Hanson and Kaar in tests conducted on beams pre-tensioned with 1/2-in. conventional strand. The observed critical length for the 1/2-in. 270K strand was found to be 80 inches, as compared with 135 inches reported by Hanson and Kaar for the conventional strand. In general, it was found that higher stresses were required to cause general bond slip with the 270K strand, than with the conventional strand. An analytical concept was developed, but a comparison with the experimental results is not included, mainly due to the lack of sufficient information on the development of friction, mechanical action, and the coefficient of creep in concrete. Author

N68-21435# Army Materials and Mechanics Research Center, Watertown, Mass. Applied Mechanics Research Lab.
STRESSES AND BUCKLING IN THIN DOMES UNDER INTERNAL PRESSURE
Jiro Adachi Jan. 1968 18 p refs Presented at 1st Intern. Conf. of the Center for High Energy Forming, Estes Park, Colo., 19–23 Jun. 1967
(AMMRC-MS-68-01; AD-666216)

Review of the state-of-the-art in analysis of the behavior of thin domes under internal pressures, specifically constant thickness torispherical domes, shows that extremely accurate prediction of stresses and critical buckling pressures for carefully machined domes can be achieved. However, forming procedures such as spinning and explosive forming produce domes of such variable quality and erratic, unpredictable behavior that accurate, efficient design is not possible. Thus an important area of study for explosive forming advocates should be development of techniques which permit accurate control and close reproducibility. Author (TAB)

N68-21501# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEADY MOVEMENT OF CRACKS AT STRAIGHT-LINE JOINT BETWEEN TWO ELASTIC MATERIALS [O STATSIONARNOM DVIZHENII TRESHCHINY PO PRYAMOLINENOY GRANITSE SOYEDINENIYA DVUKH UPRUGIKH MATERIALOV]
R. V. Gol'dshteyn 21 Jul. 1967 24 p refs Transl. into ENGLISH from Inzh. Zh. Mekhan. Tverd. Tela (Moscow), no. 5, 1966 p 93–102
(FTD-HT-23-596-67; AD-666127)

The stress distribution around the head of a crack in its steady motion along the interface of two different elastic materials

bonded together is discussed by investigating the problem of motion of a semi-infinite crack with a constant velocity along the rectilinear boundary of two different homogeneous isotropic, elastic half-spaces under conditions of plane deformation. It is assumed that equal concentrated forces of opposite directions are applied to the edges of the crack and are moving with the same velocity as the point of the crack so that the distance between the point and forces remains constant. The crack propagation rate is supposed to be lower than the velocity of sound (and of transverse stress waves) in the materials of both half-spaces. Fourier transformation of boundary and cohesion conditions with respect to the coordinate along the direction of crack propagation is used, and the solution is reduced (by applying the conventional technique of the Wiener-Hopf method) to that of the Riemann-Hilbert problem with piecewise-constant coefficients for a system of functions. The effects of the surface wave velocities in both half-spaces and of the crack-propagation rate on the stress intensity are analyzed in detail, and the interdependence between stresses, elastic constants of materials, and the propagation of the crack point is established. The vibratory character of stresses and displacements at the head of the crack is also discussed, as well as the finiteness of stresses, their sinusoidal distribution and singularity, the flow of energy, and the steady propagation of the crack. Author (TAB)

N68-21503# New York Univ., N. Y. Research Div.
STRESS AND DEFORMATION ANALYSIS OF FLEXIBLE BALLOONS Final Report, Jan. 1965–Jan. 1967
Arnold D. Kerr Mar. 1967 13 p refs
(Contract AF 19(628)-4990)
(NYU-AA-67-105; AFCRL-67-0345; AD-666437)

An analytical and experimental research program directed toward defining the failure mechanisms in polyethylene balloons is described. References are given that contain a more detailed discussion of obtained results. Author (TAB)

N68-21511# California Univ., Berkeley. Div. of Applied Mechanics.
LINEAR ELASTIC DIPOLAR PLATES
E. L. Kyser Dec. 1967 33 p refs
(Contract Nonr-222(69))
(AM-67-16; AD-666308)

The linear dipolar field equations for an initially flat surface are presented, and are applied to an elastic isotropic surface. The equations separate into extensional and bending equations, and the extensional equations are discussed in detail. A general representation of the extensional solution is obtained, and is used to solve the stress concentration problem of an infinite initially flat surface with a circular hole subjected to uniform radial tension at infinity. The stress concentration factor differs from those obtained or implied by other theories (both classical and non-classical), and the differences are discussed. Agreement with the classical result is obtained in one limiting case. Author (TAB)

N68-21604# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL SHOCK ALONG THE OUTER CONTOUR OF A RING WITH CONSIDERATION OF VISCOUS ELASTIC DAMPING OF OSCILLATIONS IN THE MATERIAL
Yu. S. Rudnyts'kyy 18 Aug. 1967 12 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR. (Kiev), no. 11, 1965 p 1455–1460
(FTD-HT-66-547; AD-666081)

Starting from the heat conduction equation the author solves theoretically the two-dimensional dynamic axisymmetric problem of thermoelasticity. The thermal shock is applied along the outer contour of a ring immersed in a medium of constant temperature (at the initial instant of time the contours temperature is raised suddenly to a specific temperature). The heat transferred through the inner contour of the ring is negligible compared to the heat transferred through the ring sides. The solution is derived within Kelvins medium (replacing Hookes medium) which is Viscoelastic and thus damps the resulting oscillations. TAB

N68-21611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEFORMATION OF MEMBRANE SHELLS OF ROTATION
V. I. Usyukin 18 Aug. 1967 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 2, 1964 p 134–140
(FTD-HT-66-539; AD-666488)

The calculation of the shape of shells subjected to internal pressure and tensile stresses was investigated. Membrane shells are defined as momentless elastic shells which cannot support compressive stresses; the shell displacements are assumed small and, consequently, one can utilize linearized equations. The form of such shells may be obtained by first dividing the shell into several regions of unspecified length and then solving the system of differential equations with appropriate boundary conditions; the system of differential equations and boundary conditions actually fixes the length of every region of the shell, and by matching these sections one obtains the shape of the deformed shell.

Author (TAB)

N68-21663# Oklahoma Univ. Research Inst., Norman.
FABRICATION AND FULL-SCALE STRUCTURAL EVALUATION OF SANDWICH SHELLS OF REVOLUTION COMPOSED OF FIBER GLASS REINFORCED PLASTIC FACINGS AND HONEYCOMB CORES Final Report
Gene M. Nordby, W. C. Grisman, and Charles W. Bert Ft. Eustis, Va. Army Aviation Materiel Labs. Nov. 1967 111 p refs
(Contract DA-44-177-AMC-164(T))
(USAAVLABS-TR-67-65; AD-666480)

Large sandwich cylinders, truncated cones, and curved panels composed of fiber glass-epoxy facings and honeycomb cores were fabricated and tested as a part of a larger research program designed to bring acceptability of reinforced plastics for primary load-bearing members of Army aircraft structures. The many aspects of tooling for and fabrication of these large shells (up to 58-inch diameter and 72 inches long) by autoclave cure were examined in detail. To generate preliminary data on this mode of shell failure, the shells were designed to fail in buckling. The tests were carried out on a testing machine capable of applying 3,000,000 inch-pounds of bending moment, of torque, or of each in combination. Curved-panel compressive test values agreed reasonably well with the approximate theoretical analyses available, but agreement of test and analysis was not good for the shear loading. Preliminary interaction relations were confirmed tentatively for the combined torsion and bending of the cylinders and truncated cones. Author (TAB)

N68-21713# Technische Univ., Berlin (West Germany). Inst. fuer Konstruktionslehre.
BUCKLING OF ORTHOTROPIC SANDWICH CYLINDRICAL SHELLS [UEBER DIE BEULUNG ORTHOTROPER SANDWICH-ZYLINDERSCHALEN]
E. Giencke Bundesministerium fuer Wiss. Forsch. 31 Jul. 1967 36 p refs In GERMAN; ENGLISH summary
(BMwF-FB-67-25) CFSTI: HC$3.00/MF$0.65

Basic formulas derived from linear theory to determine the buckling load of cylindrical sandwich shells with finite transverse shear stiffnesses are given. Due to the large torsional and shearing strength of the sandwich shells, the influence of excentricity from stiffeners is negligible. Several approximations in the plastic range, with aluminium alloy 7075-T6 as sample, are compared. Author

N68-21767*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REMARKS ON IMPERFECTIONS OF AXIALLY LOADED CYLINDERS
Robert E. Reed, Jr. Washington Apr. 1968 13 p refs
(NASA-TM-X-1552) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A simple hypothesis is offered as an explanation for the large discrepancy between theory and experiment of axially compressed cylindrical shells. It is suggested that the very low experimental buckling loads (when buckling does not occur at the ends) are caused by local "flat spots." A critical size of imperfection is given and the buckled mode shape is discussed. These arguments are also applied to other common shell buckling problems. Author

N68-21773# Southampton Univ. (England). Inst. of Sound and Vibration Research.
FINITE ELEMENT VIBRATION ANALYSIS OF CRACKED PLATES IN TENSION Technical Report, Jan. 1965–Mar. 1967
Maurice Petyt Wright-Patterson AFB, Ohio AF Mater. Lab. Jan. 1968 165 p refs
(Contract AF 61(052)-862)
(Rept.-27; AFML-TR-67-396; AD-666448)

A finite element method of analysis is developed to determine the vibration characteristics of an aircraft fuselage panel, containing a fatigue crack. Experimental observations show that as the length of the crack increases, the frequency of vibration reaches a minimum when the free edge of the crack buckles. The variation in this phenomena with increasing plate width is studied both experimentally and theoretically. The analysis is developed in a systematic manner, and calculations are performed, at each stage, on problems with known solutions, in order to determine the accuracy of the method. The problems considered include the vibrations of flat plates of varying platform, the vibrations of a cylindrical shell, the buckling of a rectangular plate, and the vibrations of a rectangular plate in compression. The method is finally applied to the problem of a cracked plate in tension and the results compared with experimental measurements. The post buckling behaviour is calculated using a step-by-step analysis to permit linearisation of the governing equations. By considering the calculated stress distributions, the variation in buckling stress with crack length and plate width is explained. Author (TAB)

N68-21790*# Southwest Research Inst., San Antonio, Tex.
TRANSMISSION CHARACTERISTICS OF CONICAL SHELLS UNDER LATERAL EXCITATIONS, PART 2 Final Report
Daniel D. Kana and William C. L. Hu Feb. 1968 75 p refs
(Contract NAS5-10312; SwRI Proj. 02-2034)
(NASA-CR-93964) CFSTI: $3.00 CSCL 20K

A theoretical and experimental study is presented for determining the steady-state frequency response of laterally excited truncated cones and cylinders in a low to moderate frequency range. The theoretical results are formulated in terms of forward transmission matrices, although relationships are reviewed which allow application of the results for impedance or admittance formulations as well. Expressions for the 4×4 matrices of transmission for coupled bending-shear displacements are developed by means of the membrane theory of thin shells. The results are then applied to the case of laterally excited shells which support a rigid top mass. Input and transfer pseudoimpedances are calculated and compared with experimental observations for 30° and 15° cones and a cylinder. Overall comparison of the results indicates that the membrane theory provides a reasonable approximation for determining response characteristics, but some definite deficiencies remain unexplained. A digital computer program is included for computing all required results. Author

N68-21781# Royal Aircraft Establishment, Farnborough (England).
THE BUCKLING BEHAVIOUR IN AXIAL COMPRESSION OF SLIGHTLY-CURVED PANELS, INCLUDING THE EFFECT OF SHEAR DEFORMABILITY
G. G. Pope Oct. 1966 41 p refs
(RAE-TR-66333) CFSTI: HC $3.00/MF $0.65

The buckling behaviour in axial compression of infinitely-long shallow cylindrical panels with simply-supported edges is analysed, taking shear deformability into account, and the slope of the load-(end strain) curve at the instant of buckling is evaluated; both orthotropic and isotropic materials are considered. The analytical results are of particular relevance to the overall buckling behaviour of panels made from sandwich and other composite materials. Author

N68-21786 California Univ., Los Angeles.
A GROUP ITERATION PROCEDURE FOR THE ANALYSIS OF COMPLEX STRUCTURES
Duane Eser Wikholm (Ph.D. Thesis) 1966 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5993

Analysis of complex structures is generally not possible by direct solution of the differential equations of elasticity. Therefore, the designer-analyst must resort to the use of numerical methods. However, if the structure is subdivided finely enough to predict stress, the number of unknowns becomes too large for simultaneous solution. Therefore, it became the purpose of this study to develop a numerical method for the solution of complex structures that would give reasonably accurate results in an efficient manner. The structure was first partitioned into a set of physically logical substructures— assumed to be joined at a finite number of points to form a model of the complete structure. The boundaries of the partitioned structure were held fixed, and the interior deflections were calculated for each substructure independently. The deflections corresponding to the release of the boundaries were then computed with the proposed group-iteration process. Dissert. Abstr.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-20585 California Univ., Los Angeles.
RADIANT HEAT TRANSFER IN NON-ISOTHERMAL GASES
Michael Murray Weiner (Ph.D. Thesis) 1966 220 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-6191

The problem of calculating radiant heat transfer rates in non-isothermal gases with prescribed distribution of temperature, pressure and composition is considered. Particular attention is given to analytical methods of calculating absorption and emission in infrared absorption bands resulting from transistions in molecular vibrational and rotational energy levels. The theoretical approach developed is based on conventional models of line-structure used to formulate the transmission of an isothermal gas in a narrow spectral interval. A complete model of an absorption band is developed by postulating local random superposition of spectral lines belonging to different vibration–rotation bands. Comparison between experiment and theory indicates that total band absorption and radiance of a non-isothermal gas column can be predicted within 10 to 25 percent. It is also shown that line-structure in

vibration–rotation bands significantly alters both the total quantity and spectral distribution of energy emitted by non-isothermal gases. Dissert. Abstr.

N68-20591 Illinois Univ., Urbana.
UNSTEADY RADIANT HEAT TRANSFER IN STATIONARY MEDIA
Kalkunte Krishna Prasad (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6701

An analytical study of unsteady heat transfer by radiation in a non-scattering, grey plane parallel layer with black boundaries is presented. The governing equation for the problem is developed from first principles. This equation is a non-linear, partial integro-differential equation with a singular kernel. A numerical technique using least squares, approximations and predictor–corrector methods is described to construct a solution to the governing equation for a step change in wall temperature. An approximate method known as the method of moments is employed to generate solutions to the problem in a semianalytical manner in a shorter time than the numerical method. Three well-known approximations for radiative flux, namely, the two stream model, optically thin and thick approximations, are shown to lead to simpler equations governing the phenomenon of unsteady radiant heat transfer. Analytical solutions to these are developed by appealing to linear perturbation techniques. Dissert. Abstr.

N68-20602 Ohio State Univ., Columbus.
THE SPECIFIC HEAT AND PHASE SEPARATION CURVE OF DILUTE SOLUTIONS OF LIQUID He^3 IN He^4
Matthew Michael Skertic (Ph.D. Thesis) 1966 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6369

The phase separation curve for dilute solutions of He^3 dissolved in superfluid He^4 has been studied by measuring the heat capacity of several dilute solutions under their own vapor pressure varying in composition from X = 4% He^3 to X = 15% He^3 at temperatures between 0.07°K and 0.70°K. The specific heat above the phase separation temperature, T_s, after the small phonon and roton contribution of the He^3 was subtracted away, was very close to that of an ideal Fermi–Dirac gas of the same He^3 number density and with effective mass $m^* = 2.5M(He^3)$, in agreement with the Pomeranchuk model. Phase separation as indicated by a discontinuity ΔC in the heat capacity was observed in only the solutions with $X \geq 8\%$. Dissert. Abstr.

N68-20662 Purdue Univ., Lafayette, Ind.
PRECISE DETERMINATION OF THE THERMAL CONDUCTIVITY OF LIQUIDS AND GAS MIXTURES
David Rees Tree (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-5507

An instrument is described for the precise measurement of the thermal conductivity of a fluid. A detailed description is given of how the minor heat losses of convection, radiation, and conduction along the lead-in wires were calculated or measured, and how these losses affected the values of the measured thermal conductivity. Three separate cases of radiation losses are examined: a perfectly opaque fluid; a perfectly transparent fluid; and a partly transparent fluid capable of emitting and absorbing radiation. Included in the third case is a description of how the absorption coefficient for each fluid is obtained. An error analysis is made and it shows that the thermal conductivity values reported in this work should have an accuracy of 1 per cent or better. Dissert. Abstr.

N68-20664 Purdue Univ., Lafayette, Ind.
THE EFFECT OF ACCELERATION ON THE BURNING RATE OF NONMETALLIZED COMPOSITE PROPELLANTS
Robert Lain Glick (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-5435

A theoretical analysis of the effects of acceleration on the burning rate of nonmetallized composite propellant with ammonium perchlorate oxidizers is presented. The analysis is directed at the high pressure range (p>600 psia) that is encountered in practice. The base for the analysis is the granular diffusion flame model originated by Summerfield, and the analysis is directed at the inclusion of acceleration effects within the basic framework of this model. The analysis shows that acceleration effects are due to the action of the acceleration field on the heterogeneous density differences in the gas phase reaction zone. Dissert. Abstr.

N68-20669 New York Univ., N. Y.
NUMERICAL STUDY OF THERMAL CONVECTION IN A FLUID LAYER HEATED FROM BELOW
Alexandre Joel Chorin (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-6010

The purpose of the present work is to study numerically the amplitude and the spatial structure of the laminar convective motions in a fluid layer heated from below. A numerical method for solving incompressible viscous flow problems is introduced. This method uses the velocities and the pressure, and is applicable to problems in two and three space dimensions. The principle of this method lies in the introduction of an artificial compressibility δ into the equations of motion, in such a way that the final results do not depend on δ. The method is first applied to two dimensional convection problems. Steady convection appears in all cases, and the dependence of the heat transfer on the Rayleigh and Prandtl numbers is studied. The results obtained are in essential agreement with results previously obtained by other methods. Three dimensional convection problems are then investigated. Dissert. Abstr.

N68-20814 Princeton Univ., N. J.
EXPERIMENTAL INVESTIGATION OF HIGH-FREQUENCY LONGITUDINAL COMBUSTION INSTABILITY IN GASEOUS PROPELLANT ROCKET MOTORS
Craig Thomas Bowman (Ph.D. Thesis) 1966 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-5704

The properties of the longitudinal mode of high-frequency combustion instability in a rocket motor burning premixed gaseous propellants have been determined experimentally. The experimental observations have been compared with the results of a non-linear instability theory based on a chemical kinetic driving mechanism. It has been shown that the theory gives the correct waveform for longitudinal instability. In addition the theory gives the correct qualitative dependence of the stability limits on the mean combustion temperature and activation energy. The theory also gives the correct qualitative dependence of the instability strength on the mean combustion temperature and mean Mach number of the combustion gases. Harmonic mode longitudinal instabilities have been observed, and a criterion for their appearance, consistent with a chemical kinetic driving mechanism, has been suggested. The dependence of the stability limits and instability strength on the mean combustion pressure, combustion chamber length, injector and exhaust nozzle have been determined experimentally. Dissert. Abstr.

N68-20840 Illinois Univ., Urbana.
HEAT CAPACITY OF DILUTE SOLUTIONS OF LIQUID He^3 IN He^4 AT LOW TEMPERATURES
William Ronald Roach (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-6713

Heat capacity measurements were made on two dilute solutions of liquid He^3 in He^4. These data, taken under saturated vapor pressure at temperatures between .005°K and .20°K, are characteristic of an ideal Fermi gas with m^* dependent only slightly on concentration. The solution with a molar concentration of He^3 of (1.32±01)% had a degeneracy temperature of (.141±002)°K and $m^*/m = 2.38 \pm .04$. For the solution with a (5.02±.03)% concentration of He^3 the degeneracy temperature was (.331±.004)°K while $m^*/m = 2.46 \pm .04$. The slight dependence of m^* on concentration can be explained in terms of the Landau theory of a Fermi liquid. The perturbation method, which Bardeen, Baym, and Pines used to determine an effective potential v(q) between He^3 quasiparticles from later data on the magnetic properties of these solutions, was used to estimate the low temperature contribution of the He^3 quasiparticles to the thermal conductivity and viscosity of dilute solutions. Dissert. Abstr.

N68-20858# Naval Ammunition Depot, Crane, Ind.
25 MILLION CANDLE CAST FLARE, DIAMETER AND BINDER STUDY, VOLUME 1 Summary Report, Jun. 1966–Jun. 1967
Bernard E. Douda Jan. 1968 84 p refs
(Contract MIPR PG-6-58)
(RDTR-105, V. 1; AD-665301)

The feasibility of making an illuminating candle which produces a luminous intensity of 25 million candles is demonstrated. The goal is achieved by igniting all surfaces of a star shaped cavity which is formed through the center of the candle. The relationship between candle diameter and the ability of that candle to generate light efficiently is reported. Silicone, epoxy-polyglycol, polyester, polysulfide, epoxy-polyester, sodium perchlorate-methyl methacrylate, and various combinations of these binders are described as they are used to make candles for the diameter study, the binder study, and the 25 million candle flare. Flame orientation and flame size effects are described. Contrary to common opinion, it is shown that a small flame size rather than a large flame from a given candle diameter is associated with candles which produce light with high efficiency. The binder is shown to be a major factor in the generation of various flame sizes and thus strongly influences the candle efficiency. Author (TAB)

N68-20859# Naval Ammunition Depot, Crane, Ind.
25 MILLION CANDLE CAST FLARE, DIAMETER AND BINDER STUDY, VOLUME 2 Summary Report, Jun. 1966–Jun. 1967
Bernard E. Douda Jan. 1968 110 p refs
(RDTR-105, V. 2; AD-665302)

The document is comprised of appendices to AD-665 301 (N68-20858). TAB

N68-20869*# Boeing Co., Seattle, Wash.
IN SITU ELECTRON RATE EFFECTS STUDIES ON THERMAL CONTROL COATINGS Quarterly Progress Report, 15 Mar.–15 Jun. 1967
Larry B. Fogdall [1967] 32 p ref
(Contract NAS5-9650)
(NASA-CR-93973; D2-84118-7; QPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Low energy electron irradiation rate testing of thermal control coatings was performed *in situ*, and changes in spectral reflectance of coating specimens were observed in vacuum throughout the 0.25 to 2.5 micron wavelength region after various exposures using electron fluxes ranging from those typical of maximum space rates to accelerated fluxes as much as 4×10^3 more intense. Degradation due to 50 keV electron exposure was found to be independent of irradiation rate. Coatings with methyl silicon binders sustained the most reflectance degradation in the infrared, while those with potassium silicate binders exhibited the largest losses in the visible spectrum. Substantial restoration of spectral reflectance toward pre-irradiation values occurs in most diffuse coatings upon re-exposure to air. M.W.R.

N68-20870# Federal Fire Council, Washington, D. C.
REVIEW OF A COLLECTION OF TEN PAPERS ON THE PROBLEM OF FIRE RISKS IN OXYGEN-ENRICHED ENVIRONMENTS
Richard L. Tuve 9 Feb. 1968 10 p refs
(AD-665796)

The report contains reviews of a collection of ten papers on the problem of fire risks in oxygen-enriched environments. Author (TAB)

N68-20998# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES
E. A. Aitken Nov. 1967 9 p refs
(Contract AT(04-3)-189)
(GEAP-5358; QR-1) CFSTI: HC $3.00/MF $0.65

The thermodynamic behavior of PuO_2–UO_2 solid solutions is described. The initial effort is a melting point study of nonstoichiometric compositions. Capsules containing sintered pellets of PuO_{2-x}, where $0 > x > 0.40$, were assembled for measurement of their melting behavior by the thermal arrest method. A conceptual model of the liquid-solid phase diagram of the urania-plutonia system was developed by using existing data and regular solution theory to account for melting point maximum at $U_{0.8}Pu_{0.2}O_{1.97}$. Preliminary analysis of the model indicates that a single interaction constant, characteristic of regular solutions, does not adequately fit the limited available data. Author (NSA)

N68-21036*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
MATERIALS ENGINEERING
Manfred Altman, Solomon Pollack, and Louis Girifalco *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Dec. 1967 9 p refs (See N68-21035 11-03)

Brief summaries are presented of previous accomplishments and this period's efforts on developing a high temperature thermal diffusivity measurement technique for thermal energy storage liquids and solid mixtures; determining the thermoelectric properties of $CuCd_2InTe_4$, $CuZn_2InTe_4$, $CuCd_2InSe_4$, and $CuZn_2InSe_4$; studying the superconducting properties of tungsten thin films by structural analysis and by electron tunneling in superconducting junctions; developing a gas pump without moving parts based on the thermal transpiration principle; and determining the thermoelectric properties of graphite compounds. R.N.A.

N68-21133# Geoscience, Ltd., Solana Beach, Calif.
INVESTIGATION OF FUNDAMENTAL MECHANISMS AND PARAMETERS THAT INFLUENCE STEADY STATE AND TRANSIENT PERFORMANCE OF RANKINE CYCLE LIQUID METAL SYSTEMS Quarterly Report, 1 Apr.–30 Jun. 1967
H. F. Poppendiek, L. V. Feigenbutz, N. D. Greene, and C. M. Sabin 30 Jun. 1967 69 p refs
(Contract AT(04-3)-677)
(GLR-55; SAN-677-15) CFSTI: HC $3.00/MF $0.65

Research activities on liquid metal boiler conditioning studies applicable to Rankine cycle systems are described. A recapitulation is made of the mathematical droplet vaporization models that were derived to help define the variations in boiling heat transfer for conditioned and de-conditioned boilers. Specifically, the parameters surface roughness, surface tension, liquid and boiler wall impurities, wall-saturation temperature differences and the physical properties are considered. A summary of mercury droplet vaporization

lifetime measurements as a function of wall-saturation temperature difference and surface roughness for Croloy 9M, Haynes 25, niobium, nickel and copper surfaces is presented. Forced, linear flow, boiling mercury conductances as functions of vapor quality and flow rate are presented for Croloy 9M, Haynes 25, and niobium. Synthesis and interpretation of the droplet vaporization and forced flow boiling measurements are presented in the light of the mathematical models and the physical and chemical parameters previously noted. Author (NSA)

N68-21148# Oak Ridge National Lab., Tenn.
DEVELOPMENT OF A 500-KW NAK-TO-AIR RADIATOR
R. E. Mac Pherson, comp. and R. J. Gray, comp. Jan. 1968 220 p refs
(Contract W-7405-ENG-26)
(ORNL-4159) CFSTI: HC$3.00/MF$0.65

Development testing and performance evaluation was carried out on a 500-kW, high-conductivity fin, multitube, and plate-fin radiator for heat transfer from NaK to air. This radiator was a prototype of the heat dump for the Aircraft Reactor Test and allowed fabrication problems and reliability of an aircraft-oriented design to be investigated. Modification of the original radiator design was required to provide greater freedom for differential thermal expansion. Thermal stresses were imposed on the tube-fin matrix during programmed thermal cycling operations and by thermal shocks during startup and occasional emergency shutdowns. Extensive postoperational metallurgical examinations revealed problem areas and suggested design modifications. Heat transfer and air pressure drop were measured on all units, and the problem of NaK-side pressure drop buildup due to temperature gradient mass transfer of nickel from the hot portions of the all-Inconel test system was studied. The effect of Na_2O concentration in the NaK on radiator pressure drop was investigated and the necessary equipment and operating techniques were developed to allow control of this variable. Author (NSA)

N68-21173# Argonne National Lab., Ill. Reactor Engineering Div.
AN ELECTRON-BOMBARDMENT-HEATED SODIUM EXPERIMENT
Robert E. Holtz Sep. 1967 57 p refs
(Contract W-31-109-ENG-38)
(ANL-7364) CFSTI: HC$3.00/MF$0.65

Experimental electron-bombardment-heating (EBH) data pertinent to the construction of a high-heat-flux, transient electron-bombardment heater is presented. Testing with both pure-tungsten and uncarburized-thoriated-tungsten, 0.030-in.-dia cathodes supplied heat fluxes of up to 371,000 Btu/hr-ft^2 to the inside surface of a 3/4-in.-dia, Schedule 160 pipe (anode). Plots are presented showing the effects of geometry, accelerating voltage, cathode temperature, diode vacuum, and cathode material upon the electron-emission current. Curves showing the EBH behavior during transient testing are also shown. Author (NSA)

N68-21179 Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
THERMAL LOAD OF SPACE FLIGHT SYSTEMS IN THE ATMOSPHERE [THERMISCHE BELASTUNG VON RAUMFLUGSYSTEMEN BEIM DURCHGANG DURCH DIE ATMOSPHAERE]
J. Lambrecht and F. Oppelt Bundesministerium fuer Wiss. Forsch. Sep. 1967 37 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-67-23) CFSTI: HC$3.00/MF$0.65

The investigation of aerodynamic heating of reusable launch systems during ascent, descent and return of the first stage to the base showed that the highest temperatures occur at typical descent trajectories. Stagnation areas require the protection of ablation materials. A multi-layer thermal protection of high-alloy steel will protect the major portion of the vehicle surface. Two multi-layer designs were investigated with respect to conduction, radiation and convection. Radiation is the most important source for higher transmission. Author

N68-21185# Idaho Nuclear Corp., Idaho Falls.
RADIATIVE AND CONVECTIVE HEAT TRANSFER WITHIN VERTICAL ANNULAR SPACES OPEN AT THE ENDS
J. C. Petrie, B. R. Dickey, and B. M. Legler Dec. 1967 58 p refs
(Contract AT(10-1)-1230)
(IN-1110) CFSTI: HC$3.00/MF$0.65

Convective and radiative heat transfer within a vertical cylindrical annulus open at the ends has been investigated. Data for natural convective heat transfer from the inner cylinder are compared with data for natural convective heat transfer from isolated surfaces. The rate of heat transfer across the annulus by conduction and convection is calculated by means of a pseudoeffective thermal conductivity, the resulting values being up to 1.8 times the effective conductivity for a completely enclosed annulus. Radiative heat transfer from the inner to the outer cylinder was calculated using a digital computer program based on the absorption factor method of Gebhart. Author (NSA)

N68-21194# Aerojet-General Nucleonics, San Ramon, Calif. Nuclear Products and Services Group.
ALKALI METALS EVALUATION PROGRAM Quarterly Progress Report, Jul. 1–Sep. 30, 1967
P. Y. Achener Nov. 1967 25 p refs
(Contract AT(04-3)-368)
(AGN-8249) CFSTI: HC$3.00/MF$0.65

Experimental runs of the thermal conductivity of cesium vapor were obtained at 1000 to 1300°F. A weld failure at a thermocouple necessitated a shutdown. The refractory metal wire holder of the vapor viscosity apparatus is completed. The determination of the liquid viscosity and liquid specific heat of lithium and sodium as well as the vapor pressure of lithium are completed. The program to determine surface tension, contact angle, and liquid thermal conductivity of lithium and sodium has begun. Results of the determination of surface tension and contact angle of lithium with 1040 ppM nitrogen are reported. Nitrogen concentration in lithium was increased by the addition of lithium nitride. The results are tabulated. NSA

N68-21199# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
FLOW INVESTIGATIONS IN COMBUSTORS WITH AERODYNAMIC FLAME STABILIZATION. PART 3: PREHEATED FLOW WITH AFTERBURNING [STROEMUNGUNTERSUCHUNGEN IN BRENNRAEUMEN MIT AERODYNAMISCHER FLAMMHALTUNG. TEIL 3: AUFGEHEIZTE STROEMUNG MIT NACHVERBRENNUNG]
W. Alvermann, R. Ulken, and M. Ahlswede 8 Jan. 1968 26 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-02) CFSTI: HC$3.00/MF$0.65

The report is a continuation and completion of this series on flow investigations in combustors with aerodynamic flame holding with a description of the investigations on a preheated flow with afterburning. The direction and the value of the flow velocity are measured satisfactorily at temperatures of more than 2000°K and velocities up to 110 m/s with cooled five-tube probes. The flow chart shows the progress of the evaluation of the data with an electronic computer. The results are compiled in direction, velocity, and temperature fields and compared with those of preceding experiments. Author

N68-21236# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorbauelemente.
REPRESENTATION OF THE HEAT TRANSFER IN CONCENTRIC ANNULAR CLEARANCES USING THE ANALOG BETWEEN IMPULSE AND HEAT EXCHANGE [DARSTELLUNG DES WAERMEUEBERGANGES IN KONZENTRISCHEN RINGSPALTEN UNTER BENUTZUNG DER ANALOGIE ZWISCHEN IMPULSE- UND WAERMEAUSTAUSCH]
Heinz Barthels Dec. 1967 134 p refs In GERMAN
(JUL-506-RB) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental studies were conducted on the turbulent heat transfer in the concentric annular space between pipes using the analogy of impulse and heat exchange for any Reynolds and Prandtl numbers, for any diameter variation, and for all modes of heating. The mathematical treatment of the problem is preceded by the determination of velocity distribution of the turbulent flow and the location of the velocity maximum in the annular space. Using these flow values, pressure losses and heat transfer were calculated. The calculated resistance values and heat transfer coefficients are compared with the measured values. Transl. by K.W.

N68-21270# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
FORCED CONVECTION BURNOUT AND HYDRODYNAMIC INSTABILITY EXPERIMENTS FOR WATER AT HIGH PRESSURE. PART 4: BURNOUT EXPERIMENTS IN A DOUBLE CHANNEL TEST SECTION WITH TRANSVERSELY VARYING HEAT GENERATION
A. Campanile, G. Galimi, and M. Goffi Brussels EURATOM Feb. 1968 37 p refs
(Contract EURATOM-008-61-12-PNII)
(EUR-3881.E) CFSTI: HC $3.00/MF $0.65

Experiments have been carried out on a complex geometry test section consisting of two heating rods coaxially mounted in two adjacent and communicating flow channels. Several conditions of differential heating in the two channels were tested to the aim of investigating the effect on burnout limits of possible variations of local flow velocity and fluid enthalpy due to transverse flow redistribution and mixing. Author

N68-21347# Deutsche Forsuchsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.
THEORETICAL CONSIDERATIONS ON A VAPORIZATION COOLING SYSTEM WITH CAPILLARY DISTRIBUTOR [THEORETISCHE UEBERLEGUNGEN ZU EINER VERDAMPFUNGSKUEHLUNG MIT KAPILLAR-VERTEILER]
A. Quast Dec. 1967 23 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-85) CFSTI: HC $3.00/MF $0.65

Theoretical calculations are indicated for a cooling system utilizing the vaporization heat. In the same way as in "Heat-Pipes" the boiling liquid is kept on the heated surfaces by open capillaries. Mach-Number and critical-heat-flux do limit the heat transport. A nuclear reactor equipped with thermionic power converters is shown as an example for the efficiency of the cooling system. At 650°C with potassium the following results were obtained theoretically: Mach-Number of vapor less 0, 3, temperature difference between reactor-core and reactor-brink less 5°C, pump-power about one hundredth of liquid-metal cooling circuit. Author

N68-21355# Aeronautical Research Council (Gt. Brit.).
THE HEATING OF AIR BY DARK DISCHARGE
J. E. Hesselgreaves, T. R. F. Nonweiler, and T. R. Foord London HMSO 1967 30 p refs Supersedes ARC-28046 See N67-20328
(ARC-R&M-3519; ARC-28046) HMSO: 13s

A theoretical and experimental investigation is made of the heating of air by means of a 'dark' or 'Townsend' discharge, the intended application being the heating of the working fluid of a hypersonic intermittent wind tunnel. Results are presented of experiments at atmospheric pressure designed to determine the efficiency of energy conversion and to test the validity of the theoretical assumptions. The theory is used to predict the performance of a small 'pilot model' heater working at 15 atmospheres pressure. Author (ESRO)

N68-21357# Royal Aircraft Establishment, Farnborough (England).
NOTES ON THE SELECTION OF OF REFRIGERANTS FOR AIRCRAFT VAPOUR CYCLE COOLING SYSTEMS
E. A. Timby Jun. 1967 42 p refs
(RAE-TR-67147) CFSTI: HC $3.00/MF $0.65

The properties of a number of refrigerants have been studied and the theoretical performance of the refrigerants most likely for airborne use considered. Choice would depend upon the specific requirements for any system, probably lying between refrigerants R12 and R114. No existing refrigerant is suitable for use at condensing temperatures over 90°C. More information is needed on stability and corrosion at elevated temperatures and on mixtures of refrigerants known as azetropes. Author

N68-21391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-MODELING PROBLEMS OF FLOW OF A COMBUSTIBLE GAS MIXTURE AROUND BODIES [AVTOMODEL'NYYE ZADACHI OBTEKANIYA TEL GORYUCHEY SMES'YU GAZOV]
G. G. Chernyy 11 Oct. 1967 29 p refs Transl. into ENGLISH from Izv. Mekhan. Zhidkosti i Gaza (USSR), no. 6, 1966 p 10–24
(FTD-MT-24-299-67; AD-666149)

The supersonic, steady-state flow of combustible mixtures in which detonation or combustion fronts are formed is of interest for supersonic combustion, for the use of steady-state detonation waves in some technological processes, and also for studying high temperature reaction kinetics. In the present study, a theoretical analysis is presented for one-dimensional or axisymmetrical supersonic flows of combustible gas mixtures over a cone, wedge or along a curved wall. New solutions were presented for a flow involving the formation of an adiabatic compression shock followed by a deflagration front. Flows over a wedge or cone with point or linear ignition sources generating deflagration fronts were also analyzed. In addition the degeneration of a detonation wave into an adiabatic shock and a combustion front was considered. In all cases, the detonation and combustion fronts were considered to have zero thickness, and it was assumed that the gas is ideal and that the specific heat on both sides of the shock is constant. The solutions are presented in the form of shock and detonation polars on u vs v diagrams (u and v are the velocity components after the shock). Author (TAB)

N68-21486# Brown Univ., Providence, R. I.
NATURAL CONVECTION FROM A HORIZONTAL CYLINDER AT MODERATE GRASHOF NUMBERS Interim Technical Report
J. A. Peterka and P. D. Richardson Wright-Patterson AFB, Ohio ARL Dec. 1967 18 p refs
(Contract F33615-67-C-1754; Grant NSF GP-4825)
(ARL-67-0275; AD-666433)

At moderate Grashof numbers, significant departures from the predictions of boundary-layer analysis are found in the flow and heat transfer from a heated horizontal cylinder. The departures can be analyzed if the full Navier-Stokes equations are used in the formulation of the problem. A set of solutions is presented for the

basic pair of simultaneous differential equations for natural convection on a horizontal cylinder for a Prandtl number of 0.72. The solution is compared with experiments for a Grashof number of about 1000, and found to be in good agreement. Author (TAB)

N68-21536*# National Aeronautics and Space Administration, Washington, D. C.

DIRECTIONAL DISTRIBUTION IN THE REFLECTION OF HEAT RADIATION AND ITS EFFECT ON HEAT TRANSFER

Benjamin Muench (Ph.D. Thesis—Swiss Tech. Coll., 1955) Apr. 1968 95 p refs Transl. into ENGLISH of the publ. "Die Richtungsverteilung bei der Reflexion von Waermestrahlung und ihr Einflus auf die Waermeuebertrangung" Zurich, 1955

(NASA-TT-F-497) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The thermal radiation properties of a surface can be characterized by its emission and reflection coefficients. An experimental apparatus is described for measuring the reflection coefficient as a function of the incident and reflected directions. All directional distributions from the purely specular to the strongly scattering were found by superposition of purely specular and diffuse results. A good approximation was found for the tests on concentric spheres. Author

N68-21575# Oklahoma Univ., Norman. School of Aerospace and Mechanical Engineering.

RADIATIVE HEAT TRANSFER IN ABSORBING, EMITTING AND SCATTERING MEDIA Final Report, Sep. 1965–Jun. 1967

Tom J. Love, Leo W. Stockham, Fu C. Lee, William A. Munter, and Yih W. Tsai Wright-Patterson AFB, Ohio ARL Dec. 1967 128 p refs

(Contract AF 33(657)-8859)

(ARL-67-0210; AD-666427)

A study is made of radiative heat transfer in systems which include absorption, emission and scattering with reflecting boundaries. The method of discrete ordinates is used for the analyses of systems with plane parallel geometry, while a Monte Carlo technique is used for the study of cylindrical geometry. Systems studied analytically include systems with experimentally determined scattering function, dielectric coatings on metallic substrates, boundary layers with scattering particles and radiation from finite cylinders. An experimental study is also made of radiative equilibrium transfer through a cloud of glass spheres falling between parallel plates. Results are compared with theory. Author (TAB)

N68-21606# Cincinnati Univ., Ohio. Inst. of Space Sciences.

PRELIMINARY ANALYTICAL EXPLORATIONS OF HEAT TRANSFER FROM BOUNDARY LAYERS CONTAINING STREAMWISE VORTICES Final Scientific Report

Leif N. Persen (Norges Tekniske Hoegskole, Trondheim) Wright-Patterson AFB, Ohio ARL Dec. 1967 73 p refs

(Contract AF 33(615)-2272)

(ARL-67-0280; AD-666438)

The present investigation is concerned with the swirling inlet flow in a cylindrical tube and the heat transfer in the entrance region. This is a chosen model problem for the Gortler-type vortices which occur in boundary layer flow in order to gain more insight in the mechanism of vortices with their axes in the streamwise directions. Conclusions are being drawn on the final breakdown of the Gortler-type vortex system and the dependence on the Reynolds number and the Prandtl number of the increase in heat transfer rates is brought out. The findings suggest that the vortex motion alone is not responsible for the large increases in heat transfer rates which have been observed. The induced motion which is created by such vortices in boundary layers is suggested as the possible mechanism responsible. Author (TAB)

N68-21608# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

DIFFUSION CONCENTRATION DISTRIBUTION NEAR AN IDEALIZED CONTACT SPOT

Kenneth R. Cramer and Kenneth J. Richards Dec. 1967 32 p refs

(ARL-67-0216; AD-666426)

The distribution of the concentration of a diffusing substance near an idealized contact spot is determined analytically for unsteady self-diffusion across only the contact region. The results demonstrate that the influence of the contact spot is restricted to less than ten spot radii in the radial direction and less than four in the axial direction. Author (TAB)

N68-21617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF PRESSURE ON INDICES OF COMBUSTION PROCESSES AND HEAT EXCHANGE IN HEAT-RESISTANT COMBUSTION CHAMBERS [VLIYANIYE DAVLENIYA NA POKAZATELI PROTSESSOV GORENIYA TEPLOOBMENA V TEPLONAPRYAZHENNYKH KAMERAKH SGORANIYA]

V. M. Ivanov 23 Aug. 1967 30 p refs Transl. into ENGLISH from Tr. Inst. Goryuch. Iskop., Akad. Nauk SSSR (Moscow), no. 56, 1965 p 40–64

(FTD-MT-24-136-67; AD-666079)

An analysis of the effect of pressure on the combustion of liquid or gaseous fuels in combustion chambers was made under the following assumptions: (1) The fuel is uniformly distributed in the air stream; (2) the liquid droplets have the same size and pressure changes do not affect atomization; (3) the velocity of the fuel droplets and the gas stream are equal, and (4) the fuel consumption and air flow rates are constant so that the combustion process takes place at a constant air excess factor. Relationships were derived for the length of the combustion zone of liquid and gaseous fuels as a function of pressure. The effect of pressure on heat transfer in the combustion chamber was also analyzed. The results were compared with previous experimental data obtained with kerosene, diesel fuel, and solar oil. The analysis showed that the length of the combustion zone of gaseous and liquid fuel decreases inversely in relation to the pressure while the heat release per unit volume increases with the square of the pressure. Radiative heat transfer does not exceed 25-30% of the total heat transfer so that no separate section for radiative transfer is required in the type of combustion chambers studied. Author (TAB)

N68-21680*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF AN ACOUSTIC LINER WITH VARIABLE CAVITY DEPTH

Bert Phillips Washington Apr. 1968 53 p refs

(NASA-TN-D-4492) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An acoustic liner with individually isolated resonators and variable cavity depths was tested with a nominal 20,000-pound thrust hydrogen-oxygen rocket engine. The liner damping was evaluated by comparing values of hydrogen-inlet temperature at transition into combustion instability. Three concentric tube injectors were studied. Test variables were liner cavity depth, number of liner rows, and axial position of the liner rows. Cavity gas temperature and composition were measured at the screech transition point. A flow-induced frequency shift using a theoretical axial gas velocity profile changed the calculated resonant frequency to a value matching the pretransition noise frequency. The amplitude of the pretransition noise oscillations associated with the three injectors affected liner damping. The most effective axial position of the resonators was determined to be closest to the injector. Effectiveness of row combinations of the resonators at some other positions was also determined. There was a much higher concentration of hydrogen and hence higher sonic velocity in the resonator cavities than had been predicted in previous reports. Author

N68-21686*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.

THE EFFECT OF PERIODIC PRESSURE AND TEMPERATURE FLUCTUATIONS ON UNSTEADY HEAT TRANSFER IN A CLOSED SYSTEM

Daniel W. Wendland 1 Mar. 1968 219 p refs
(Grant NsG-601)
(NASA-CR-72323) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The nature of the unsteady heat transfer from a closed gas system to a plane metal surface with the gas experiencing periodic pressure and temperature oscillations was studied. The gas system was defined by a piston-cylinder-head compression chamber; the piston was driven by a variable-speed motor to generate the gas pressure and temperature fluctuations. Gas pressure histories were measured with a piezoelectric pressure transducer. Gas temperatures were measured with a 3.81 micron hot-wire anemometer probe used as an uncompensated resistance thermometer. Instantaneous metal surface (the surface of the head of the chamber) temperature was measured with a fast-response surface thermocouple with a one-micron junction thickness. A mathematical technique was developed to calculate instantaneous metal surface heat transfer rates; experimentally measured surface temperature histories were introduced into a CDC 3600 digital computer program which calculated, listed, and plotted surface heat transfer histories. Author

N68-21704*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF FINNED-TUBE ASSEMBLY TECHNIQUES ON THE HEAT-TRANSFER CHARACTERISTICS OF A SPACE RADIATOR

Lawrence A. Mueller Washington Apr. 1968 20 p refs
(NASA-TM-X-1557) CFSTI: HC $3.00/MF $0.65 CSCL 13A

Nine methods of fabricating a finned-tube space radiator were tested. Both mechanical and metallurgical joining of stainless-steel tubes to aluminum meteoroid armor and fins were investigated and compared with an all-aluminum radiator. The mechanically assembled sample had a heat-radiating capacity of 125 to 236 watts per foot of tube length (410 to 774 W/m), and the metallurgically assembled samples radiated 231 to 287 watts per foot (758 to 941 W/m). A brazed assembly had the best heat-transfer characteristics. Measured thermal resistance ranged from 0.07 to 1.5 (°F)(ft)/W (0.011 to 0.258 (°K)(m)/W). Also, the metallurgically joined specimens were not affected by thermal cycling; whereas, all the mechanically assembled specimens, except the bumper finned-tube sample, were affected. Author

N68-21719# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD FOR COMPLEX SIMULATION OF NONSTATIONARY MASS AND HEAT TRANSFER PROCESSES

N. A. Fridlender 10 Jul. 1967 13 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 9, no. 5, 1965 p 577–582
(FTD-HT-67-164; AD-666077)

The article proposes a complex method of solution involving two matrices: the first matrix includes the capacities and the resistances and simulates the heat transfer and the second matrix includes the mass transfer. The cells of the matrices are interconnected, so that a change in the potential of one matrix has an effect on the change in potential of the other. The author considers the equations of heat and mass transfer in capillary porous bodies. It is assumed that a capillary porour body is partly filled with liquid and partly with vapor. Diffusion mass transfer is the result of the inhomogeneous characteristics of the concentrations and of the temperatures. Author (TAB)

N68-21732*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PARTITION FUNCTIONS AND THERMODYNAMIC PROPERTIES TO HIGH TEMPERATURES FOR H_3 AND H_2 IONS

R. W. Patch and Bonnie J. McBride Washington Apr. 1968 77 p refs
(NASA-TN-D-4523) CFSTI: $3.00 CSCL 20M

Tables of partition functions were compiled for H_3^+ and H_2^+ at temperatures from 298.15° to 56,000°K. Tables of thermodynamic properties were compiled at temperatures from 298.15° to 10,000°K. The latter tables give the following thermodynamic functions for ideal gases: heat capacity at constant pressure, sensible enthalpy, entropy at 1 atmosphere, sensible free energy at 1 atmosphere, enthalpy, and free energy at 1 atmosphere. The heats of formation at 298.15°K are also given. Since no band spectra have been observed for either ion, all calculations were based on ab initio potential energy calculations found in or derived from the literature. All results for H_2^+ are reliable up to 15,000°K, but results for H_3^+ are tentative at all temperatures. A digital computer program to calculate Wentzel–Kramers–Brillouin rotational energies from the potential energy of a diatomic molecule or molecular ion is also included. The program is in FORTRAN IV. Author

N68-21742*# National Bureau of Standards, Boulder, Colo.

THERMODYNAMIC DEPRESSIONS WITHIN CAVITIES AND CAVITATION INCEPTION IN LIQUID HYDROGEN AND LIQUID NITROGEN Final Report, 15 Jul. 1964–15 Dec. 1967

J. Hord, D. K. Edmonds, and D. R. Millhiser Mar. 1968 95 p refs
(NASA Order C-35560-A)
(NASA-CR-72286; NBS-9705) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Cavitation characteristics of liquid hydrogen and liquid nitrogen in a transparent plastic venturi have been determined. The experimental data are presented in tabular and graphical form. Conventional cavitation-inception-parameter and head-velocity curves are given over the range of experimental temperatures (36.5 to 41°R for hydrogen and 140 to 170°R for nitrogen) and inlet velocities (70 to 185 ft/sec for hydrogen and 20 to 70 ft/sec for nitrogen). Minimum local wall pressure at incipience was calculated to be less than bulkstream vapor pressure by as much as 328 feet of hydrogen head and 63 feet of nitrogen head in some inception tests. Thermodynamic data, consisting of pressure and temperature measurements within fully developed cavities, are also given. Author

N68-21774# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.

ANALYSIS OF HEAT TRANSFER IN A THREE-LAYER HOLLOW CYLINDER: CONSTANT RADIAL FLUX ENTERING THE OUTSIDE SURFACE AND ZERO FLUX LEAVING THE INNERMOST SURFACE

Eva M. Thorn 15 Nov. 1967 115 p refs
(NWEF-1014; AD-666106)

The one-dimensional time-dependent equation of heat conduction in cylindrical coordinates is solved for an infinite three-layer hollow cylinder. The conventional Laplace transform technique is not employed, but rather the method of separation of variables is applied with a novel eigenfunction expansion of the initial temperature distribution. Boundary conditions considered are a constant flux entering the outside surface of the cylinder in the direction of a radial vector and a zero flux leaving the innermost surface. Author (TAB)

N68-21825# Explosives Research and Development Establishment, Waltham Abbey (England).
HEAT TRANSFER TO SUPERCRITICAL KEROSINE
J. C. Beech 27 Feb. 1967 59 p refs
(ERDE-14/R/66; WAC/173/015) CFSTI: HC $3.00/MF $0.65

Forced convection heat transfer from the outside surfaces of electrically heated circular tubes to kerosine flowing in a rectangular cross-section duct was studied. The investigation covered pressures between 20 and 80 kg/cm^2, and heat fluxes of up to 60 cal/cm^2 sec. Surface temperatures up to 500°C, extending through the supercritical region, were attained. The influence of the material of the heated surface was found to affect greatly the amount of carbon formed on the surfaces, and hence surface temperatures. Results obtained using nickel, gold-plated and stainless steel surfaces suggest that nickel surfaces promote the pyrolysis of kerosine by catalysis. The deposition of carbon can be minimized by using stainless steel or gold-plated surfaces. An attempt also is made to correlate experimental data, including those in the "boiling-like" region, in terms of enthalpy differences between the fluid at the hot surface and that in the turbulent core. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-20871# Congress. House. Committee on Science and Astronautics.
PANEL ON SCIENCE AND TECHNOLOGY, NINTH MEETING. APPLIED SCIENCE AND WORLD ECONOMY
Washington GPO 1968 284 p Hearings before Comm. on Sci. and Astronautics, U. S. House of Representatives, 90th Congr., 2d Sess., No. 1, 23–25 Jan. 1968

Proceedings are presented for a three-day session on applied science and world economy before the House of Representatives Committee on Science and Astronautics. Principal discussion topics concerned (1) utilization of technological resources for human welfare, (2) geographic distribution of technical resources, (3) market mechanisms in the applications of technology, and (4) coupling technology to the economy. International aspects of technology utilization are considered. M.W.R.

N68-20885# RAND Corp., Santa Monica, Calif.
DESIGN CONSIDERATIONS FOR A COMPUTER-ASSISTED MAINTENANCE PLANNING AND CONTROL SYSTEM
S. M. Drezner and R. L. van Horn Feb. 1968 61 p refs
(P-3765; AD-665451)

The paper describes the design considerations for a Computer-Assisted Maintenance Planning and Control System, called CAMCOS, to support an Air Force base-level maintenance organization in the planning and control of its activities. TAB

N68-20958# Logistics Management Inst., Washington, D. C.
DEFENSE INDUSTRY VALUE ENGINEERING PROGRAM REVIEW
Feb. 1968 64 p refs
(Contract ARPA SD-271)
(AD-665679)

Significant opportunities appear to exist for increasing defense industry participation and effectiveness in the DoD Value Engineering Program through stimulating a much greater exploitation of the savings sharing potential of industry-initiated Value Engineering Change Proposals (VECPs). It is concluded that defense industry will probably increase its VECP activity significantly: (1) When it is generally convinced that its DoD customer is receptive to industry-initiated VECPs. (2) When DoD VECP processing time is reduced and the quality and quantity of VECP feedback information are improved. (3) If the DoD closely monitors experience and problems under the current VE Armed Services Procurement Regulation provisions and makes timely corrections as necessary to maintain strong industry motivation. (4) If all concerned DoD and defense industry personnel have a thorough understanding of the intent, objectives and procedures of the DoD VECP Program. Author (TAB)

N68-20990# Los Alamos Scientific Lab., N. Mex.
SCIENTIFIC ADVENTURING AND MISADVENTURES
Thomas L. Shipman and Roy Reider 29 Dec. 1967 8 p Presented at the AEC and Contractors Safety and Fire Protect. Meeting, Argonne, Ill., 19 Sep. 1967
(Contract W-7405-ENG-36)
(LA-3827) CFSTI: HC $3.00/MF $0.65

An historical background is presented for various scientific adventures or experimental discoveries, as is an overview of ideas about teaching sciences. Good work habits to insure productivity and success are stressed, and it is noted that it is not always the A student who gets ahead. M.W.R.

N68-21187# Advisory Group for Aerospace Research and Development, Paris (France).
STATUS AND ORGANIZATION OF TECHNICAL AND SCIENTIFIC DOCUMENTATION AND INFORMATION IN THE FEDERAL REPUBLIC OF GERMANY
Heinz Lechmann Oct. 1965 20 p refs Presented at 16th Meeting of AGARD Tech. Inform. Panel, Washington, 7 Oct. 1965
(AGARD-545) CFSTI: HC $3.00/MF $0.65

The technical and scientific documentation and information centers in the Federal Republic of Germany are listed, both for civil purposes and for defense, and gives the functions of each and their co-ordination together. Author

N68-21265# Congress. Senate. Committee on Science and Astronautics.
NASA AUTHORIZATION FOR FISCAL YEAR 1969
Washington GPO 1968 711 p Presented at the hearings before Subcomm. on Space Sci. and Appl., 90th Congr., 2d Sess., no. 3, pt. 3, 19–21, 26–29 Feb. 1968
GPO: HC $2.25; CFSTI: MF $0.65

An overview is presented on the Office of Space Science and Applications accomplishments, and specifics are given on the FY 1969 plans for the lunar and planetary programs, the physics and astronomy programs, bioscience, space applications, launch vehicles, administrative operations, and facility construction. The views of scientists on the proposed planetary program are presented, along with comments from aerospace industry representatives engaged in working on the Earth Resources Satellites Systems. Funding plans for the NASA sustaining university program are included. M.G.J.

N68-21276# Congress. Senate. Committee on Science and Astronautics.
NASA AUTHORIZATION FOR FISCAL YEAR 1969
Washington GPO 1968 751 p Presented at the hearings before Subcomm. on Advan. Res. and Technol., 90th Congr., 2d Sess., No. 3, Pt. 4, 19–22, 26–29 Feb. 1968
GPO: HC $2.25; CFSTI: MF $0.65

Administrative operations are discussed in relation to the Office of Advanced Research and Technology, and a detailed account is given on the program planning necessary to provide

technical information in support of national decisions on new development projects in space and aeronautics. Budget requests are presented on the eight R&D programs: space power and electric propulsion, nuclear rockets, space vehicle systems, electronic systems, aeronautical vehicles, human factors systems, chemical propulsion, and basic research. Achievements of the Technology Utilization Program are documented to support the funding requests for identification and publication, evaluation, dissemination, and analysis of technological advances that may have application in nonaerospace endeavors. The Office of Tracking and Data Acquisition funding trends are charted. Research and development operations and equipment are discussed for the Manned Space Flight Network, Satellite Network, Deep Space Network, other instrumentation, communications, and data processing, along with the amounts needed for constructing facilities. M.G.J.

N68-21505# Frankford Arsenal, Philadelphia, Pa. Quality Assurance Directorate.

ENVIRONMENTAL CRITERIA AND SIMULATION METHODS RESEARCH STUDY

Maurice H. Simpson and David Askin Dec. 1967 67 p refs
(R-1876; AD-666185)

The primary function of development and testing of Army material is to ensure that material scheduled for worldwide use satisfies minimum operational, technical, and safety requirements in all types of environments and troop operational employment. Accordingly, design and test criteria must provide factual bases for technical doctrine to support operational objectives and improved combat capability. The research program employs systems approach and operations analyses techniques applied to a viable environmental situation to develop environmental criteria and simulation methods. A model is developed that is devoid of arbitrary factors and is, thereby, realistic to natural environments of field and storage (standby) operations. Systems concepts are used to encompass the effects of multi-environmental complexes. Artificial and psuedo-environmental concepts are removed so that better correlation of laboratory testing with field performance is made possible. Fundamentally underlining this research approach is the concept that hardware failures are always symptomatic of disorder in a particular dynamic system. Emphasis is on the constructive method of research wherein it is considered that an event is always the result of an interaction of several coexisting factors, and that hazards are not haphazard but exhibit patterns that can be identified. The event is studied as a whole, then the operative factors are gradually sorted out by a series of increasingly precise approximations. Overall relationships are maintained intact, correctly placed in relationship with each other and held in contact, yet they are differentiated. Author (TAB)

N68-21761# Defense Dept., Washington, D. C.

PERSONNEL MANAGEMENT FOR R AND D

Donald M. Mac Arthur 28 Feb. 1968 7 p ref Presented at the Soc. for Personnel Admin., Washington, D. C.
(MAM-68-3; AD-666544)

The report discusses some of the problems and issues in the field of civilian personnel administration as they relate to Department of Defense (DoD) laboratories. TAB

N68-21828*# National Aeronautics and Space Administration, Washington, D. C.

MANAGEMENT. A CONTINUING LITERATURE SURVEY WITH INDEXES, 1962–1967

Mar. 1968 29 p refs
(NASA-SP-7500) CFSTI: HC $3.00/MF $0.65 CSCL 05A

A compilation of references to unclassified reports and periodicals on the subject of management that may be found in the NASA scientific and technical information system is reported. The publication assembles groups of citations formerly announced in separate journals, Scientific and Technical Aerospace Reports (STAR) and International Aerospace Abstracts (IAA), to provide management with a convenient information tool. Contents include material generated or sponsored by NASA during the period 1962 through 1967. Abstracts in the survey are grouped under the following categories: program management, contract management, research and development, management tools and techniques; personnel management; urban management; management policy and philosophy; economics; and general which includes conference proceedings, reviews, patent information, speeches, and bibliographies. S.C.W.

N68-21836# Congress. Senate. Committee on Aeronautical and Space Sciences.

APOLLO 6 MISSION: SUMMARY OF THE PROBLEMS ENCOUNTERED IN THE SECOND FLIGHT OF THE SATURN 5 LAUNCH VEHICLE

Washington GPO 1968 37 p Hearing before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess., 22 Apr. 1968

Summarized are senate committee hearings on problems encountered during the second flight of Saturn V. Focused on are engine problems, and structural problems induced by anomalies in the engines. Reported are statements of James E. Webb, Administrator, NASA; Dr. George E. Mueller, Associate Administrator for Manned Space Flight; Major General Samuel C. Philips, USAF, Director, Apollo Program for Manned Space Flight; and George H. Hage, Deputy Director, Apollo Program for Manned Space Flight. S.C.W.

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